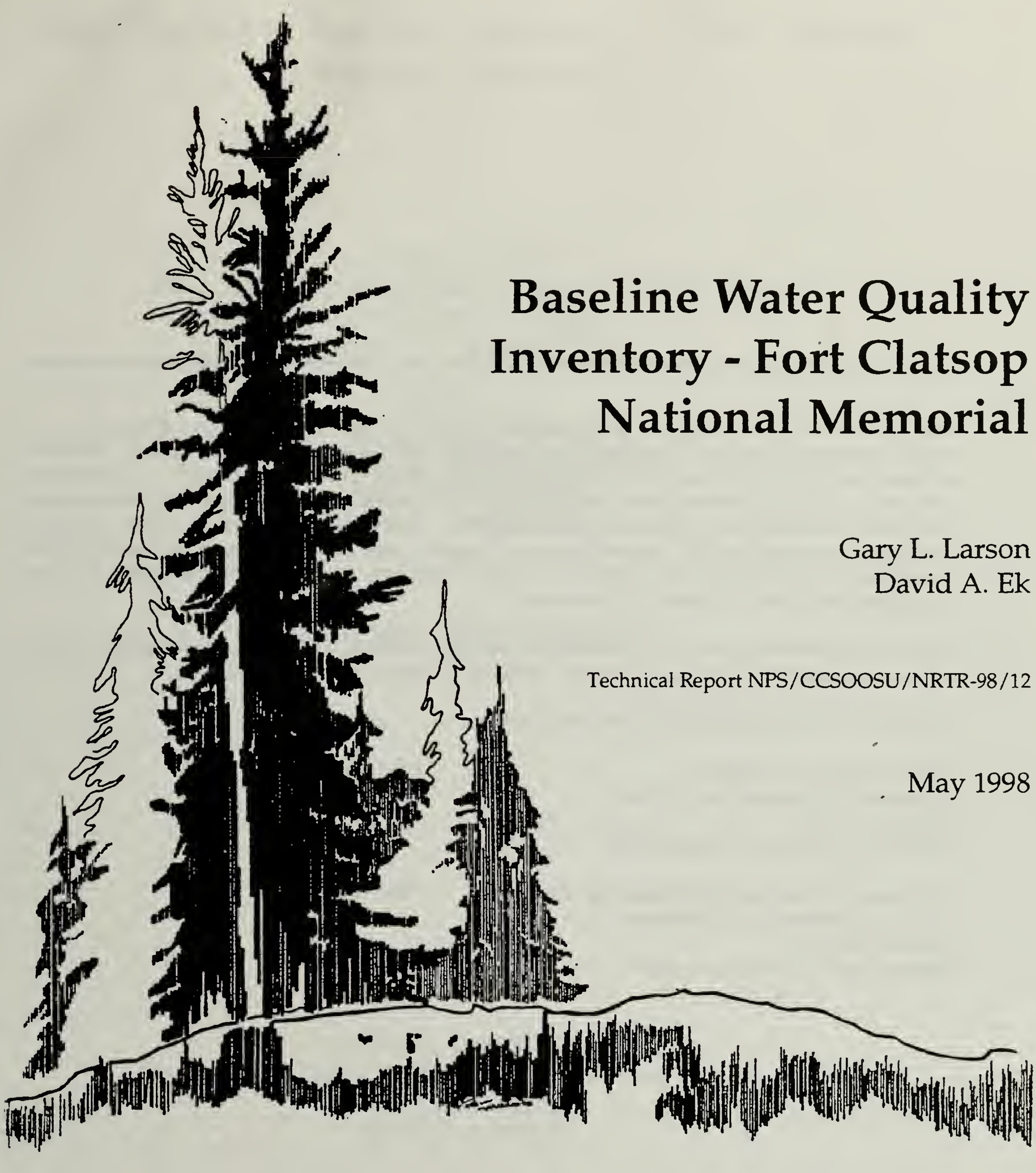
Resource Room copy FOCL



Baseline Water Quality Inventory - Fort Clatsop National Memorial

Gary L. Larson
David A. Ek

Technical Report NPS/CCSOOSU/NRTR-98/12

May 1998

United States Department of Interior - National Park Service

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Abstract

A general water quality survey of selected water resources was conducted at Fort Clatsop National Memorial (FOCL) during the period from 1994 to 1997. The sampling sites included the Lewis and Clark River and an associated slough, two permanent streams, one ephemeral stream, two ephemeral springs, and three ephemeral ponds. The water quality characteristics among the sites were relatively diverse and variable. Seasonal changes of most water quality variables were pronounced. No obvious impacts from human-related activities were observed, with the exception of dioxin/furan contamination of the sediment in the Lewis and Clark River. Based on the results of this initial survey, a long-term water quality monitoring program was recommended to document normal average conditions for each variable at each sampling site. FOCL was encouraged to seek advice and assistance from local, state, and federal agencies to interpret its water quality data and to assess the importance of the data to the management of the Lower Columbia River Estuary System.

Introduction

Fort Clatsop National Memorial (FOCL), located in northwestern Oregon, commemorates the culmination and winter encampment of the Lewis and Clark Expedition following its successful crossing of the North American Continent in 1805 (Fig. 1). Park managers recognize that the natural setting of the Memorial is a central theme of the management program, and that water quality of streams, the Lewis and Clark River, springs, ponds and associated wetlands are important components of the natural setting. One aquatic system has particular significance in regard to the purpose of the memorial, namely the spring (Historic Spring) believed to be used by the Lewis and Clark Expedition in the winter of 1805/1806 as a source of drinking water.

Water resources of the monument are diverse and range in type from brackish riverain systems to ephemeral springs, ponds, and streams. These include the tidally-influenced Lewis and Clark River, two unnamed brackish sloughs, four ephemeral streams, two ephemeral springs, ten types of wetlands identified by the National Wetlands Inventory System comprising approximately 40% of the park's surface area (a component of the Lower Columbia River wetlands and estuary system), forested wetlands not identified by the National Wetlands Inventory, and groundwater.

An overview of the FOCL water resources and issues was conducted by staff from the National Park Service (NPS) Water Resources Division in 1992. Staff from this Division conducted another site visit in 1993 while providing technical assistance. The Division prepared a Water Resources Scoping Report for FOCL in 1994. These reports highlighted a lack of basic inventory data and several external and internal threats to the park's water resources. These

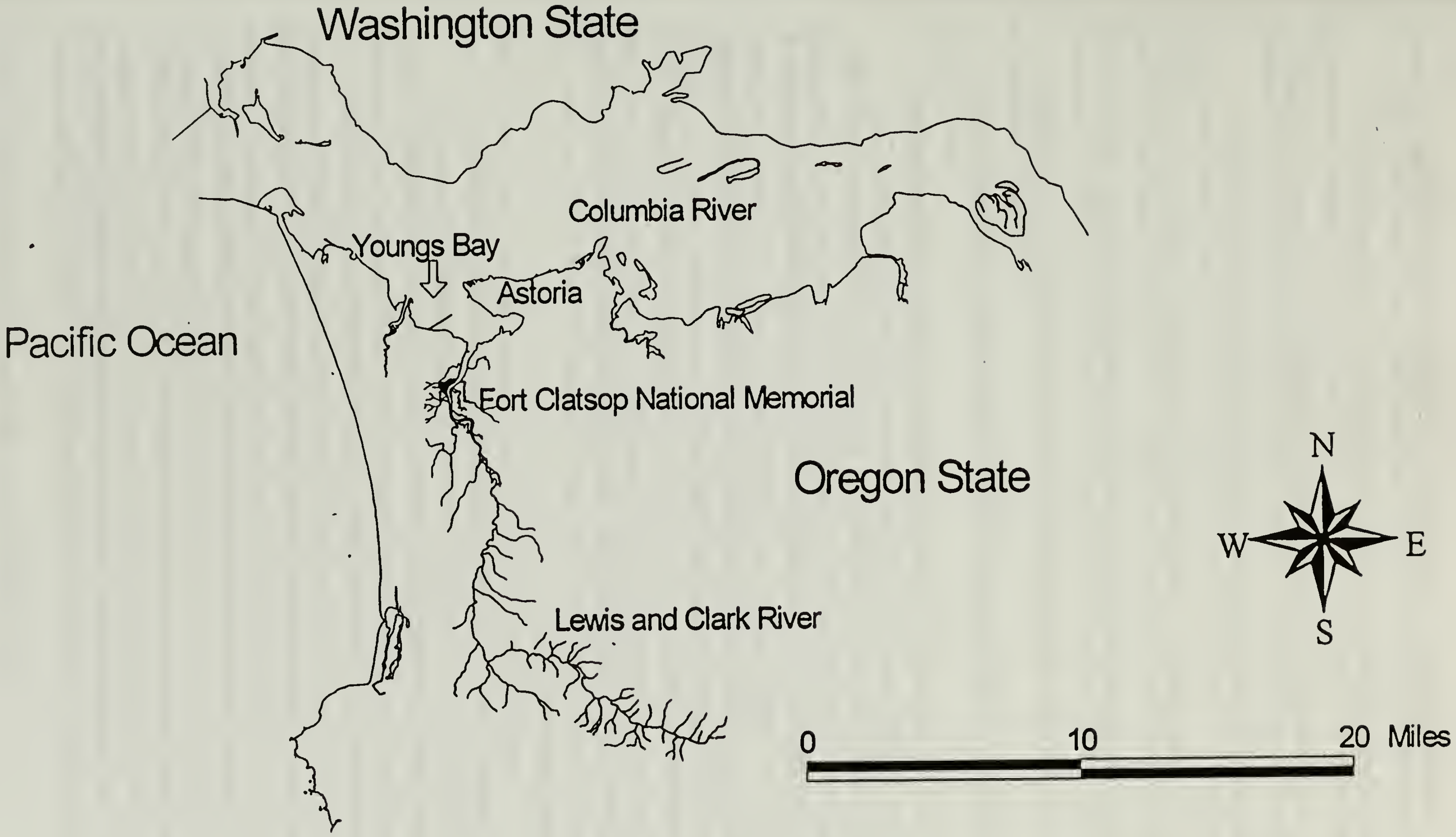


Figure 1. Geographical location of FOCL.

threats continue to include: the routine dredging of the Lewis and Clark River by the U.S. Army Corps of Engineers; agricultural land-use practices (including the use of pesticides and fertilizers); logging and residential development in the upper portion of the park's watersheds; possible septic systems leakage from residences located outside of the park; moderate to extensive diking of wetlands and other water diversions in and adjacent to FOCL; and possible effects from National Park Service buildings and facilities on the Historic Spring. The site visits by the Water Resources Division also highlighted the significance of the water and wetland resources and the suitability of conducting successful wetland restoration projects at FOCL.

Threats to water resources of FOCL are not independent of other local and regional concerns about water quality and loss of wetlands. All of the FOCL water resources drain into the Columbia River Estuary, and the Lewis and Clark River and associated wetlands are part of this estuarine system. Thus, FOCL has the opportunity and responsibility to participate in water quality issues and contribute to the acquisition of baseline information about this system. These efforts would compliment other ongoing projects throughout the lower Columbia River Estuary (Larry Small, personal communication).

FOCL was funded in 1995 by the NPS Water Resources Division to conduct an inventory of the water quality of selected FOCL water resources. The goals of the project were to: (1) develop an understanding of the water quality of aquatic resources ; (2) protect and restore, and interpret for the public the water quality of aquatic resources; (3) develop a data base on the water quality of aquatic resources for comparison with future conditions; and (4) compile a data base on water quality that can be used in future studies at FOCL, e.g., classification and mapping of wetlands, wetlands restoration, water quality monitoring, and aquatic flora and fauna inventories.

The objectives of the project were to: (1) document temporal changes of water quality of representative aquatic resources; and (2) evaluate the water quality of representative aquatic resources in the Memorial for anthropogenic impacts, and if impacts were detected, offer mitigation actions. There were two parts to the project. The first was a brief study of water quality and sediment chemistry of the Lewis and Clark River conducted by Tetra Tech (1996). Comments on this study are found in the discussion of this report. The second part of the project is presented in this report.

Study Area

FOCL consists of three disjunct units totaling 125.2 acres. Visitor services are located within the 108 acre larger unit and the 100 foot by 100 foot Salt Works Site unit situated within downtown Seaside, OR. The third unit of FOCL is a 17-acre wetland. The main and eastern units of FOCL are located on either side of the tidally-influenced portion of the Lewis and Clark River, one mile upriver from the confluence with the Columbia River at Youngs Bay (Fig. 1). The Lewis and Clark River is located less than four miles from the Pacific Ocean. The Lewis and Clark River is one of the last streams to empty into the Columbia River.

Topography of the main unit of FOCL varies from the relatively flat mudflats and estuaries of the Lewis and Clark Valley to the steeper forested slopes and benches of the eastern toe-slope of Clatsop Ridge. Elevation ranges from sea-level to 60 feet. Climate consists of relatively warm and dry summers and fall with cool and wet winter and spring. Rainfall averages approximately 70 inches per year at the Astoria Airport. Due to the relatively high rainfall coupled with the large amount of moisture obtained from frequent fog, there are many surface streams and springs within this borderline temperate rainforest. Within this small park, there are at least 10 fresh-water streams and many small isolated ponds.

The streams of FOCL appear to be similar hydrologically to other small streams in the northern Oregon Coast Range. The land is quickly drained by an extensive network of drainage channels. These flow paths are quick to flood during heavy rains and quick to return to normal flow shortly after the rain stops. Snowpack is not an issue for any of these streams because they are feed by rain and groundwater. As a consequence, the peak flows begin around November and taper off around February to reach the late summer low-flow period in September. However, the tide level of the Lewis and Clark River is greatly dependent upon the flow of the Columbia River. The Columbia River's peak flows are primarily related to snow-melt. Therefore, the mixing zone of these two systems has a high variability and complexity, partly due to the two systems being "out-of-phase" with one another.

Geomorphological information about each study site is listed in Table 1, whereas the location of each sampling site is shown in Fig. 2. Acronyms for the study site are shown in Table 2.

The Lewis and Clark River (LECL) is one of the principal drainages within the lower reaches of the Columbia River, draining 161 km^2 (62 mi^2). The river originates in commercial and State forest lands near Saddle Mountain (Fig. 1). Much of the river is high gradient through these forest lands. The low gradient reaches of the river are tidally-influenced, although estuarine waters are blocked from every side channel by tide gates, extensive dikes, levees and water diversions. These lower reaches of the river contain an extensively-developed farm land environment. Besides farms, this region has also been known for extensive dairy operations. However, depressed dairy economics have eliminated most of these dairies, and in their place are either mostly idle pasture lands or high-densities of hybrid cottonwood trees managed on an

Table 1. Morphological characteristics of the study areas, FOCL.

Name	Drainage	Drainage-Within Park	Length	Length-Within Park	River Mileage*	Elevation/ Gradient #	Surface Area
	(Hectares)	(Hectares)	(Meters)	(Meters)	(Meters)	(Meters)	(Square Meters)
Lewis and Clark River	16,058	50.6	41,581	1,609	4,018 (97%)	488 0 1.2%	
Alder Creek	18.1	10.7	1,098	360	640 (58%)	23 2 1.9%	
Salamander Creek	3.9	3.7	278	278	110 (40%)	13 3 3.6%	
Corner Creek	200	4.3	3,274	24	2,145 (65%)	30 2 0.9%	
Historic Spring	2.0	2.0	354	354	177 (50%)	7 2 1.5%	
Iron Spring	4.8	4.8	366	366	36,600	9 2 1.9%	
South Boundary Slough	266	2.1	1,759	34	0	34 2 1.6%	
Association Pond							approx. 279
Clay Pit Pond							270
Ephemeral Pond							4.8

Notes:

* = Location along the length of the water course, measured in meters from the mouth of the stream. The percentages within this column indicate the location along the length of the water course; measured in percentage, from the mouth of the stream- for instance mid-way along the stream would be 50%, 100 meters from the mouth of a 1,000-meter stream would be 10%, the headwaters would be 100%.

# = Elevation/Gradient. The first number is the elevation, in meters, of the streams headwaters. The second number is the elevation, in meters, of the stream's mouth. The third number is the percent grade of the stream, derived by dividing the streams elevational change between the source and mouth by the stream's length.

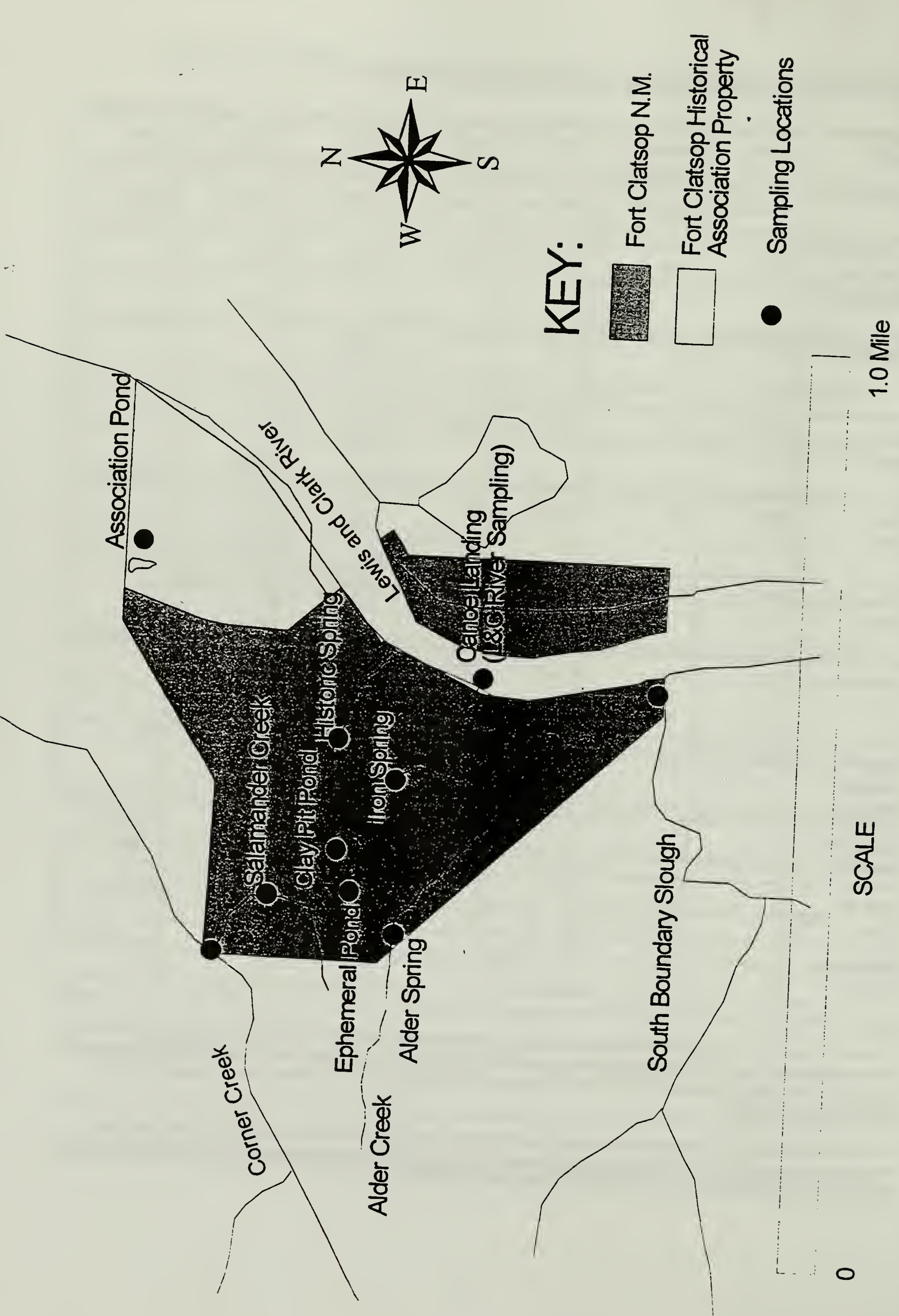

Association Pond
Lewis and Clark River
Canoe Landing (L&C River Sampling)
Salamander Creek
Clay Pit Pond
Historic Spring
Iron Spring
Ephemeral Pond
Alder Spring
Corner Creek
Alder Creek
South Boundary Slough
N
E
S
W
KEY:
Fort Clatsop N.M.
Fort Clatsop Historical Association Property
Sampling Locations
SCALE
0
1.0 Mile

Table 2. List of acronyms for sample locations, Fort Clatsop National Memorial.

Sample Location	Acronym
Alder Creek	ALCR
Corner Creek	COCR
Salamander Creek	SACR
Lewis and Clark River	LECL
South Boundary Slough	SBSL
Historic Spring	HISP
Iron Spring	IRSP
Clay Pit Pond	CLPO
Association Pond	ASPO
Ephemeral Pond	EPPO

eight-year harvest rotation. Historically, the lower river corridor had been used extensively as a commercial waterway, transporting log rafts, as well as supporting light-industrial activities.

The LECL is utilized by several anadromous fish species, including coho salmon, chinook salmon, chum salmon, steelhead trout, Dolly Varden, and sea-run cutthroat trout. There also is an important American shad fisheries within the river. The lower reaches of the LECL and Young's Bay, into which the river drains (Fig. 1), also is an important rearing-ground for juvenile salmon, flounder, sole, and dungeness crab.

Alder Creek (ALCR) is the provisional name of a small creek that originates in commercial timber lands west of the park and eventually drains into the Canoe Landing Slough that is connected to the LECL (Fig. 2). The creek flows through these forests along a gravel logging road until it enters a dirt sinkhole at the FOCL boundary. A short distance within FOCL the creek resurfaces at "Alder Spring". From this point, the creek flows through wetlands along a small-valley bottom. A tide gate holds back tidal waters from the LECL and the Canoe Landing Slough. A large assortment of trash is routinely dumped into the creek from a logging road each year. Much of this trash, some believe to contain toxic substances, enters the creek.

Iron Spring (IRSP) is the provisional name of a small spring and creek that originates within FOCL, just south of the picnic area (Fig. 2). IRSP is actually composed of two springs that flow into each other. These springs flow a short distance south to the Canoe Landing Slough.

South Boundary Slough (SBSL) is the provisional name of a multi-branched creek that originates within commercial timber lands southwest of the park (Fig. 2).This creek eventually flows into a large wetland and beaver ponds within a private ranch land adjacent to FOCL. Two -thirds of this large wetland is located within this private ranch/pasture land and one-third within

FOCL. Immediately before draining into the LECL, the creek flows through a tide gate, and under the Fort Clatsop Loop Road.

Corner Creek (COCR) is the provisional name of a creek that originates in commercial timber lands west and northwest of FOCL (Fig. 2). The creek flows through only a small corner of FOCL before flowing back into commercial timber lands, then along private residences, other commercial operations, a tide gate, and then eventually flows into the LECL.

Salamander Creek (SACR) is the provisional name of a small creek that lies entirely within FOCL (Fig. 2). It originates from forested wetlands and eventually flows into COCR at the northwest corner of the park. SACR usually stops flowing during the summer months; however, the creek beds remains wet year-round.

Historic Spring (HISP) is the provisional name of a very small spring and creek that begins from wetlands adjacent to the FOCL visitor center (Fig. 2). Near the origin of the creek, it flows through several culverts under parking lots, roads, and other developments within FOCL. A portion of the stream channel was rerouted in 1991 for the construction of the visitor center. A short distance from the visitor center the creek (under normal flows) submerses within fine sediments. The creek surfaces again a short distance later at the HISP. From the spring site, the creek plunges down a short waterfall and then meanders through shrub and forested wetlands and bottom lands and then flows into the LECL. The lower portions of the creek are not tidally influenced, due to an old levee/dike that blocks tidal waters. The creek seeps through this old dike into the LECL. During high-water periods, water not only comes from the spring, but also from surface waters in the small drainage channel upstream from the spring.

Clay Pit Pond (CLPO) is the provisional name of a pond that was excavated in the 1870s and 1880s when a local settler mined clay from the wetland (Fig. 2). CLPO lies at an elevation of 39 feet above sea level within a forest environment. There are no surface waters draining into or out of the pond. Hydrologically, the pond is believed to be connected with the HISP drainage since it is connected to the wetland that forms the source of the spring. The pond is an important amphibian breeding site, containing northern red-legged frogs, Pacific tree frogs, rough-skinned newts, and the Northwest salamanders.

Ephemeral Pond (EPPO) is a the provisional name of a small pond that is located near CLPO (Fig. 2). It is believed to be hydrologically connected with IRSP. Due to its small size and transitory nature, no amphibians have ever been observed utilizing the pond.

Association pond (ASPO) is the provisional name of a pond located on the Fort Clatsop Historical Association (FCHA) property (Fig. 2). The pond is located along the northern edge of the FCHA parcel, adjacent to an old berm. On the opposite side of the berm is a drainage canal maintained by FCHA's more northern neighbor- a part-time family rancher than maintains a pasture for cattle. Drainage off the pasture is fed into this canal that eventually, via a tide gate, empties into the LECL. Since ASPO partly rests against this berm, it is believed that the pond is at least partly an artificial creation. However, the berm is quite old. ASPO is in an open grassland environment (mostly the exotic Reed Canary Grass) and it is usually choked (vertically as well as horizontally) with algae and algal mats. ASPO is an important amphibian breeding area, utilized by at least five different species of amphibians.

Methods

Water quality samples were collected routinely on a sampling schedule that ranged from 1 or more times each month from 1995 to 1997, with additional samples collected at HISP, ASPO, CLPO, COCR, LECL, and SACR in 1993 and 1994. Standard methods and techniques were used (Table 3). Hydrogen-ion concentration was used to calculate average pH values. Water samples for nutrient and ion analyses were collected in June 1995, and April and October 1996. Nutrient and ion analyses were performed by the Cooperative Chemical Analytical Laboratory, using standard methods and techniques (Tables 4 and 5). Percent saturation of dissolved oxygen samples were calculated using a nomogram, assuming zero altitude (Wetzel 1975). Locations of the sampling sites at the study areas were documented as shown in Table 6. Lynne Johnson of the FOCL staff recorded the initial observed dates of drying and recharge of SACR, HISP, IRSP, CLPO, and ASPO during the scheduled sampling visits to these sites. EPPO was visited mostly at the monthly intervals. Thus, the dates of drying and recharge of EPPO were not as well defined as for the other ephemeral sites. Annual values of each variable were calculated based on the averages of each variable per month per year. Insufficient data were available to address seasonal changes in the concentrations of nutrients and ions.

Results

Hydrologic Regimes

Five sample sites were ephemeral, lacking either standing or flowing surface water during summer and early fall (Table 7). ASPO typically was dry from late May-early June to mid-late October. The other sites typically dried in July or mid-August. CLPO refilled with water (recharged) in September or early October. The two springs (IRSP and HISP) and SACR regained surface flow in October. EPPO typically dried in March or May and recharged in October or November.

Annual Water Quality

The average monthly discharge of each of the three streams and two springs in FOCL was less than 1 CFS, with the exception of COCR, which had a discharge of 2.4 CFS (Table 8).

Table 5. Analytical Methodology used by the Cooperative Chemical Analytical Laboratory, Forest Sciences Laboratory, 3200 S.W. Jefferson Way, Corvallis, Oregon (Cameron Jones, Personal Communication).

Analysis	Method
Total Phosphorus	Persulfate digestion, ascorbic acid finish
PO_4-P	Reactive phosphate, ascorbic acid finish
Kjeldahl-N	Nessler's Reagent finish
Nitrate-N	Automated cadmium reduction
Ammonia-N	Colormetric automated phenate
Calcium	Flame atomic absorption
Potassium	Flame atomic absorption
Magnesium	Flame atomic absorption
Chloride	Flame atomic absorption
Sulfate-S	Method 4110B

Table 6. Location of water quality sampling sites at each study area, FOCL (see Fig. 2).

Study Area	Sample Location
LECL	From the river bank at a location referred to as the Canoe Landing site (Fig. 2). Most samples were collected during high-tidal periods.
SBSL	Pool located immediately upstream of the tide gate.
ALCR	Immediately downstream from Alder Spring.
COCR	Northwest corner of FOCL
SACR	Immediately upstream from a waterfall 3 m (10 ft) in height.
HISP	At the spring.
IRSP	Immediately downstream from the lowest and largest of the two springs.
CLPO	Adjacent to trail, from shore
ASPO	Adjacent to dike, from shore
EPPO	Adjacent to trail, from shore

Table 7. Dates of drying and dates of recharge in two ponds (ASPO and CLPO), two springs (IRSP and HISP), and one stream (SACR) at FOCL by year.

Sample Site	Year	Date Observed Dry	Date Rechange Observed
ASPO	1995	May 30	October 16
	1996	June 4	October 29
	1997	May 28	June 10
		July 9	September 17
		September 30	October 17
CLPO	1995	July 11	October 2
	1996	August 7	September 19
	1997	August 7	September 3
IRSP	1995	July 3	October 10
	1996	July 6	October 16
	1997	August 12	October 8
HISP	1994	?	October 20
	1995	July 18	October 2
	1996	August 13	September 16
		October 2	October 8
	1997	Not Dry (pools in summer and early fall)	Not Applicable
SACR	1995	July 3	October 16
	1995	July 6	October 16
	1997	August 12	October 8
EPPO	1995-January 1997	March / May	October / November

Table 8. Average monthly discharge (CFS) and observed minimum and maximum discharges at five sampling locations, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Discharge	SD	n	Minimum	Maximum
ALCR	12	0.62	1.27	26	0.01	8.70
COCR	12	2.41	4.83	27	0.01	33.17
SACR	11	0.22	0.36	20	0.0	2.13
HISP	12	0.12	0.15	24	0.0	1.06
IRSP	11	0.05	0.09	20	0.0	0.83

Minimum discharges of ALCR and COCR were less than 0.1 CFS, while those of SACR, HISP, and IRSP were 0.0. Maximum discharges of the streams ranged from 2.1 (SACR) to 33.2 CFS (COCR). Maximum discharges of HISP and IRSP were 1.1 and 0.8 CFS, respectively.

LECL and SBSL had the highest average monthly water temperatures at 14.1 and 13.8 °C, respectively (Table 9). Temperatures at the other sites ranged from about 10 to 11°C. Minimum water temperatures at all sample sites were less than 9 °C, whereas maximum temperatures of the streams were between 14 and 16 °C. Maximum temperatures of LECL and SBSL were 24 and 23 °C, respectively. The maximum temperature of EPPO was only 12 °C, presumably because it dried before the warm summer season.

The average monthly turbidities of the sample sites ranged from 1.1 to 31.0 NTU (Table 10). LECL had the highest turbidity and EPPO the lowest. ALCR was substantially less turbid that was COCR. SACR was less turbid that ALCR and COCR. The turbidity of IRSP was twice that of HISP. Although CLPO was similar in turbidity to EPPO, ASPO was the most turbid sampling site at FOCL. The minimum turbidities at all sample sites were less than 4 NTU, whereas the maximum turbidities of COCR, LECL, and ASPO were 696.0, 364.0 and 827 NTU, respectively. The maximum turbidities of the other sites did not exceed 70.0 NTU. In fact, the turbidities of ALCR and SACR did not exceed 26.2 NTU.

The average monthly pH of the study sites ranged from 4.8 (EPPO) to 6.4 (LECL).The pH of CLPO was 5.2, whereas those of ASPO and SACR were 5.7 (Table 11). ALCR and COCR had a pH of 6.0. Both springs had pH values of about 5.5. Minimum pH values ranged from 4.0 (EPPO and HISP) to 5.3 (SBSL) and 5.4 (LECL). The maximum pH values exceeded 8.0 in COCR, LECL, and SBSL. The maximum values at the other sites ranged from 6.5 to 7.2, with the exception of EPPO which was at 5.5.

Table 9. Average monthly water temperatures (°C) and observed minimum and maximum water temperatures at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Water Temperature	SD	n	Minimum	Maximum
ALCR	12	10.9	2.2	39	5.0	15.0
COCR	12	10.8	3.1	41	3.0	16.0
SACR	10	10.1	1.8	31	6.0	14.0
LECL	12	14.1	5.2	83	4.0	24.0
SBSL	12	13.8	5.2	29	2.5	23.0
HISP	12	11.1	1.8	119	7.0	16.0
IRSP	12	11.1	1.9	98	8.0	15.0
CLPO	11	10.4	2.7	68	5.0	22.0
ASPO	11	11.7	3.6	47	6.0	23.0
EPPO	8	9.7	0.8	23	8.0	12.0

Table 10. Average monthly turbidity (NTU) and observed minimum and maximum turbidities at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Turbidity	SD	n	Minimum	Maximum
ALCR	12	5.2	3.3	38	1.3	26.2
COCR	12	8.3	8.5	37	1.5	112.0
SACR	10	2.2	0.7	29	1.2	5.9
LECL	12	31.0	21.2	79	1.4	364.0
SBSL	12	13.6	6.0	29	3.8	31.5
HISP	12	3.9	4.1	117	0.5	55.9
IRSP	12	8.2	19.6	99	0.2	70.0
CLPO	11	1.7	1.0	70	0.4	7.2
ASPO	10	38.3	38.3	45	2.1	827.0
EPPO	8	1.1	0.4	23	0.3	2.9

Table 11. Average monthly pH values and observed minimum and maximum values at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month		All Data		
Sampling Site	n	pH	n	Minimum	Maximum
ALCR	12	6.0	43	4.7	6.5
COCR	12	6.0	39	5.0	8.6
SACR	10	5.7	29	4.5	7.2
LECL	12	6.4	74	5.4	8.5
SBSL	12	6.3	29	5.3	8.6
HISP	12	5.5	112	4.0	6.8
IRSP	12	5.6	95	4.8	6.8
CLPO	11	5.2	60	4.2	6.7
ASPO	10	5.7	43	4.7	6.5
EPPO	8	4.8	23	4.0	5.5

The average monthly alkalinity of the study sites ranged from 7.9 (EPPO) to 39.9 (LECL). The alkalinity of SBSL was 35.0 (Table 12). For FOCL streams, alkalinity ranged from 9.4 (SACR) to 18.0 (ALCR). The alkalinity of IRSP was about twice that of HISP. Alkalinities of the ponds were low and similar to that of SACR, with the exception of ASPO which had an alkalinity of 26.6 mg/L. Collectively, minimum alkalinities did not exceed 14.0 mg/L, with most sites not exceeding 6 mg/l. Maximum alkalinities were substantially higher than the minimum values at each site. The highest maximum values occurred at IRSP (86.0 mg/L), LECL (78.0 mg/L), and SBSL (74.0 mg/l).

The average monthly conductivity among the study sites ranged from 50.9 (HISP) to 158.2 µS/cm, with the exceptions of LECL and SBSL that had conductivities slightly greater than 1200.0 µS/cm (Table 13). Minimum conductivity values ranged from 30 to 50 mµS/c, whereas maximum values ranged from 70 to 8000 uS/cm. The highest values occurred in LECL and SBSL. The maximum value in ASPO (1600 µS/cm) was substantially greater than those in CLPO and EPPO.

Collectively, the average monthly dissolved oxygen concentrations of the water samples from the study sites ranged 4.6 (EPPO) to 10.1 (SACR) mg/L (Table 14). ALCR, COCR, SBSL and LECL had concentrations exceeding 9.0 mg/L. Concentrations in the two springs and ASPO were between 7.0 and 8.0 mg/L. CLPO had an average concentration of 7.2 mg/L. Minimum concentrations were typically less than 6 mg/L with the exceptions of LECL (6.6 mg/L) and SACR (7.0 mg/L). The maximum concentrations ranged from 9.1 (EPPO) and 13.5 (ASPO) mg/L. Maximum concentrations at the other sites ranged from 9.8 to 12.6 mg/L.

The percent saturation of dissolved oxygen followed the general pattern for dissolved oxygen concentrations as described in Table 14. On the average, LECL and the creeks had the highest percent saturations (Table 15). EPPO had the lowest average value.

Table 12. Average monthly alkalinity (mg/L) and observed minimum and maximum alkalinities at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Alkalinity	SD	n	Minimum	Maximum
ALCR	12	15.5	6.5	32	6.0	38.0
COCR	12	18.0	8.8	32	6.0	40.0
SACR	10	9.4	2.7	22	4.0	16.0
LECL	12	39.9	12.9	62	14.0	78.0
SBSL	12	35.0	18.5	23	11.0	74.0
HISP	12	13.5	3.4	91	4.0	26.0
IRSP	12	22.8	17.6	80	7.6	86.0
CLPO	11	9.7	2.5	49	4.0	18.0
ASPO	10	26.6	7.3	35	10.0	48.0
EPPO	8	7.9	1.7	17	4.0	12.0

Table 13. Average monthly conductivity (μS/cm) and observed minimum and maximum conductivity at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Conductivity	SD	n	Minimum	Maximum
ALCR	12	63.4	15.1	37	50.0	140.0
COCR	12	72.2	27.4	39	50.0	200.0
SACR	10	45.3	7.3	29	30.0	70.0
LECL	12	1273.1	1212.4	81	45.0	8000.0
SBSL	12	1204.7	1309.3	29	45.0	8000.0
HISP	12	50.9	5.8	117	30.0	70.0
IRSP	12	72.7	15.6	99	50.0	170.0
CLPO	11	73.8	19.4	62	50.0	200.0
ASPO	11	158.2	166.	47	40.0	1600.0
EPPO	8	58.5	3.6	23	50.0	70.0

Table 14. Average monthly dissolved oxygen (mg/L) and observed minimum and maximum dissolved oxygen at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Dissolved Oxygen	SD	n	Minimum	Maximum
ALCR	12	9.6	1.6	34	5.3	11.6
COCR	12	9.9	1.6	35	4.9	12.4
SACR	10	10.1	0.6	25	7.0	11.9
LECL	12	10.0	1.4	66	6.6	12.2
SBSL	12	9.3	1.6	26	5.5	12.6
HISP	12	7.5	1.2	100	4.0	10.3
IRSP	12	7.4	2.3	89	0.5	10.8
CLPO	11	5.8	1.3	56	1.7	9.8
ASPO	10	7.2	1.8	36	1.0	13.5
EPPO	8	4.6	1.4	19	2.3	9.1

Table 15. Average monthly percent saturation of dissolved oxygen and observed minimum and maximum and values at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Percent Saturation	SD	n	Minimum	Maximum
ALCR	12	86.2	10.4	34	51.0	98.0
COCR	12	88.3	9.53	35	49.0	108.0
SACR	10	89.8	4.2	25	65.0	100.0
LECL	12	96.2	4.4	64	72.0	126.0
SBSL	12	87.9	6.3	26	61.0	104.0
HISP	12	67.6	8.7	98	37.0	94.0
IRSP	12	67.4	17.6	87	14.0	100.0
CLPO	11	51.7	9.5	55	17.0	85.0
ASPO	10	66.9	18.9	36	12.0	120.0
EPPO	8	40.0	12.8	19	20.0	79.0

Salinity was below detection limits in samples collected for all but LECL and SBSL (Table 16). For LECL and SBSL the average monthly values were 1.6 mg/L at SBSL 1.5 mg/L at LECL, respectively. Both sites had minimum values of 0.0 mg/L. The maximum values were 6.0 and 8.0 for SBSL and LECL, respectively.

Nutrient concentrations were variable among the sampling sites (Table 17). ASPO had the highest average concentrations of UTKN, FTKN, UTP, FTP, PO4-P, NH3-N, and SO4-S. HISP typically had low or the lowest concentrations of these water quality variables. EPPO had the highest concentration of NO3-N, whereas ASPO had the lowest. SBSL had the highest concentrations of Na, K, Ca, Mg, and Cl, followed by ASPO (Table 18). All sites had relatively high concentrations of Cl.

Seasonal Water Quality

Discharge: The discharge of ALCR, COCR, SACR, HISP, and IRSP were high in winter and low in summer; the latter three drying in summer (Figs. 3-5). The highest discharges occurred in December in some years. The average discharges and minimum-maximum discharges for each study site by month are shown in the Appendix (Table 19).

Turbidity: Three of the study sites exhibited seasonal changes in turbidity (Figs. 6-10). During winter the turbidity of ALCR and CLPO was low and then increased during summer and, in some years, early fall. In contrast, the turbidity of LECL was highest during winter. Periods of high turbidity at the other study sites were variable during the year. The average turbidities and minimum-maximum turbidities for each site by month are shown in the Appendix (Table 20).

Temperature: With the exception of EPPO, owing to the fact the it was dry during several months each year, the study sites exhibited considerable temporal changes in water temperature

Table 16. Average monthly salinity (%) and observed minimum and maximum salinity at each sampling location, FOCL. [n = sample size, SD = 1 standard deviation].

	Per Month			All Data		
Sampling Site	n	Salinity	SD	n	Minimum	Maximum
LECL	12	1.5	1.7	85	0.0	8.0
SBSL	12	1.6	2.0	29	0.0	6.0
ASPO	11	0.2	0.5	49	0.0	3.0

Table 17. Concentrations (mg/L) of nutrients in water samples collected at selected sampling sites in 1995 and 1996, FOCL. [UTKN = unfiltered total Kjedldahl-N; FTKN = filtered total Kjeldahl-N; UTP = unfiltered total phosphorus; FTP = filtered total phosphorus].

SITE	N	UTKN	FTKN	UTP	FTP	PO4-P	NO3-N	NH3-N	SO4-S
ALCR	3	0.253	0.120	0.038	0.012	0.004	0.647	0.032	1.423
ASPO	2	2.755	1.785	0.695	0.551	0.451	0.013	0.554	12.345
CLPO	3	0.553	0.447	0.052	0.020	0.004	0.262	0.047	0.465
COCR	3	0.390	0.310	0.032	0.017	0.006	0.568	0.051	1.340
EPPO	1	3.720	0.140	0.0	0.007	0.002	1.451	0.031	1.270
HISP	3	0.087	0.080	0.012	0.008	0.002	0.628	0.010	0.332
IRSP	3	0.283	0.070	0.200	0.012	0.006	0.712	0.020	1.053
SACR	3	0.217	0.135	0.051	0.002	0.002	0.528	0.005	0.190
SBSL	1	0.240	0.150	0.068	0.029	0.012	0.179	0.027	7.400

Table 18. Concentrations (mg/L) of sodium, potassium, calcium, magnesium, and chloride in water samples collected at selected sampling sites in 1995 and 1996, FOCL.

SITE	N	Na	K	Ca	Mg	Cl[1]
ALCR	3	9.00	0.89	1.94	1.56	15.39**
ASPO	2	16.25	2.89	8.64	7.86	18.68*
CLPO	3	8.50	0.96	1.43	1.83	18.63**
COCR	3	10.03	0.89	2.43	1.85	15.99**
EPPO	1	7.70	0.52	1.33	1.78	-
HISP	3	6.72	0.56	2.09	1.77	11.33**
IRSP	3	10.80	0.60	2.45	2.26	15.97**
SACR	3	8.30	0.46	1.12	1.32	13.67**
SBSL	1	51.2	3.00	12.00	8.82	53.09*

[1]* n = 1

** n = 2

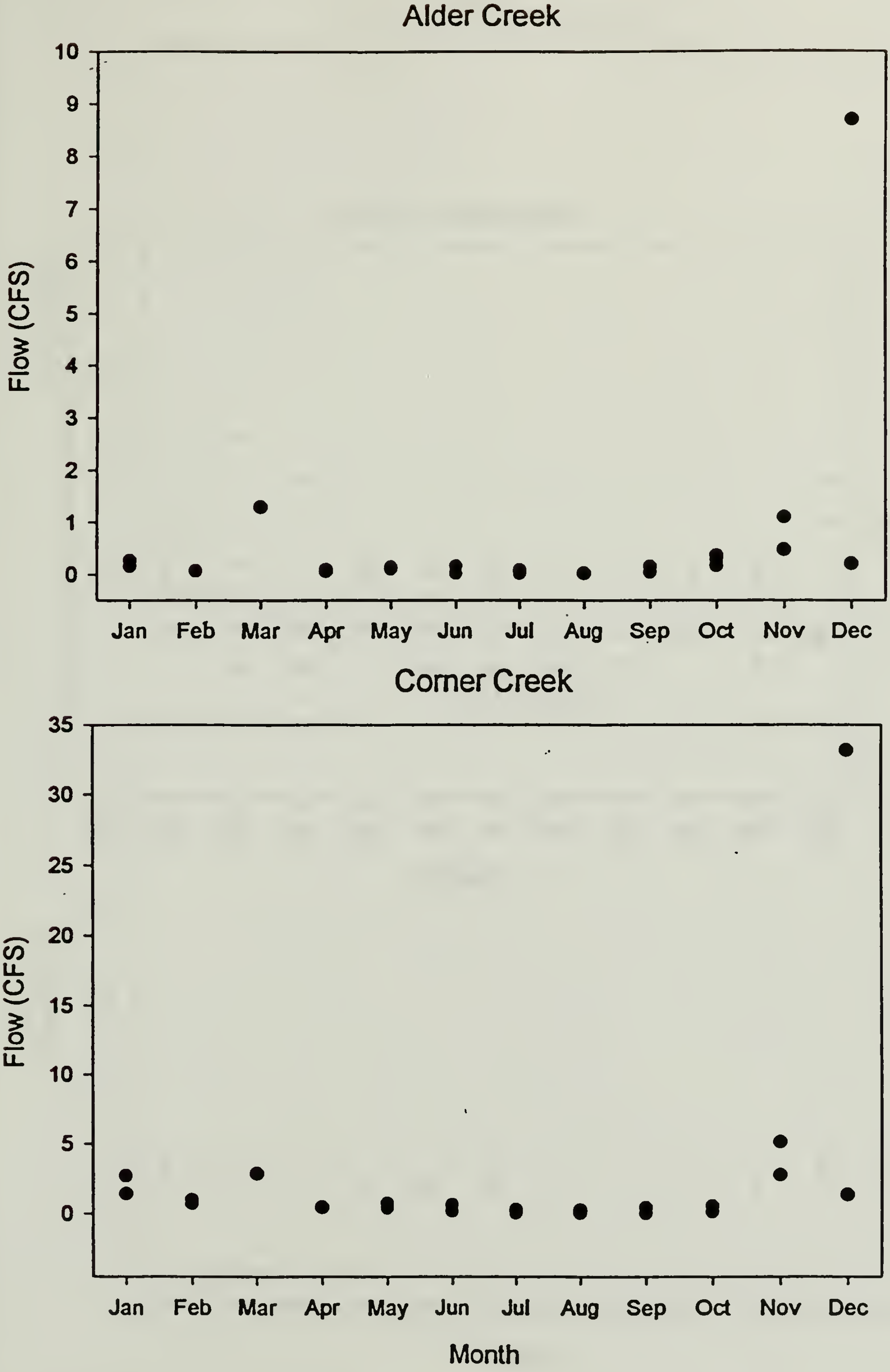


Figure 3. Monthly discharges of Alder Creek and Corner Creek, FOCL.

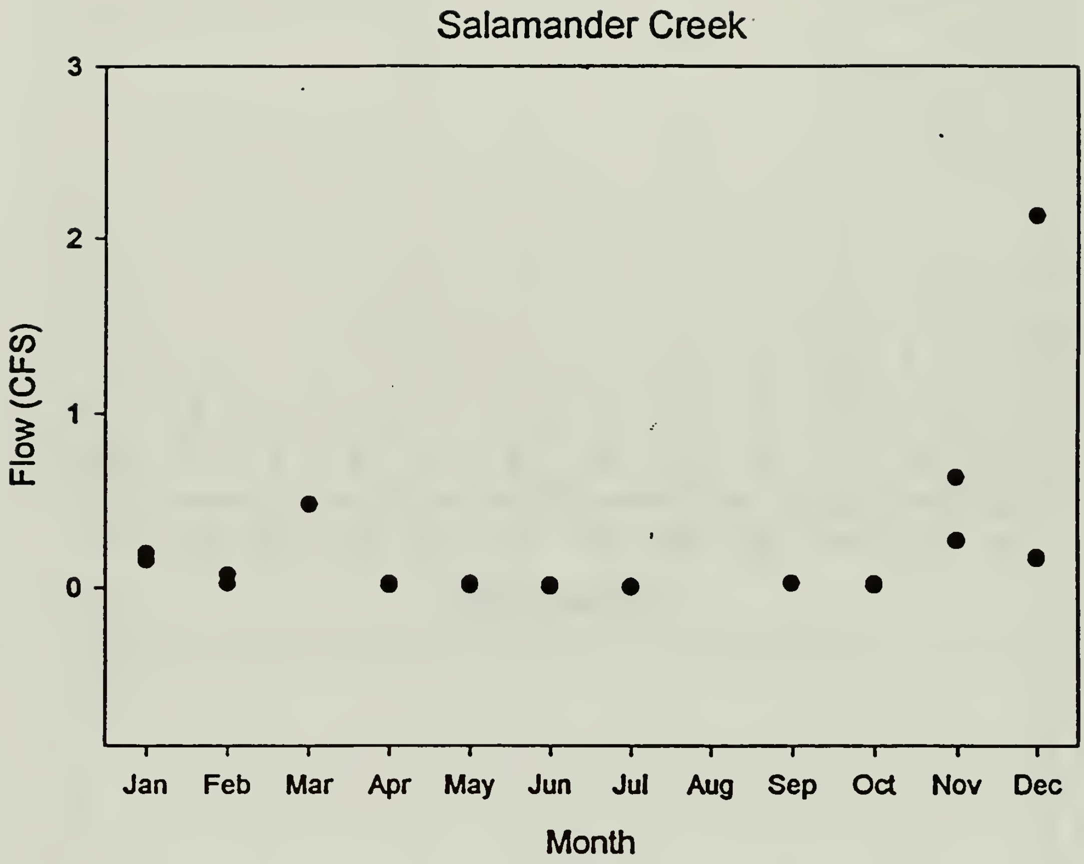


Figure 4. Monthly discharges of Salamander Creek, FOCL.

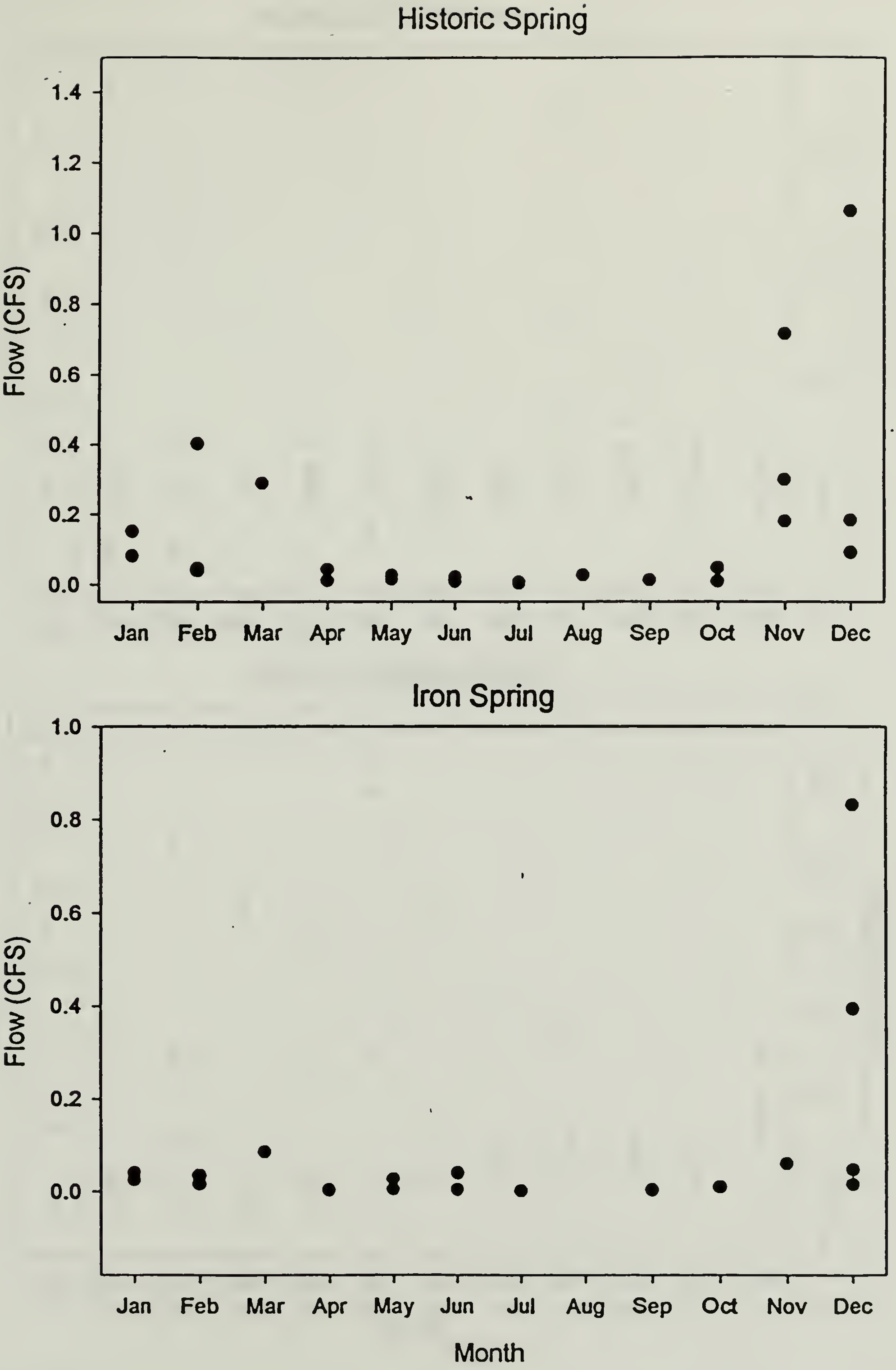


Figure 5. Monthly discharges of Historic Spring and Iron Spring, FOCL.

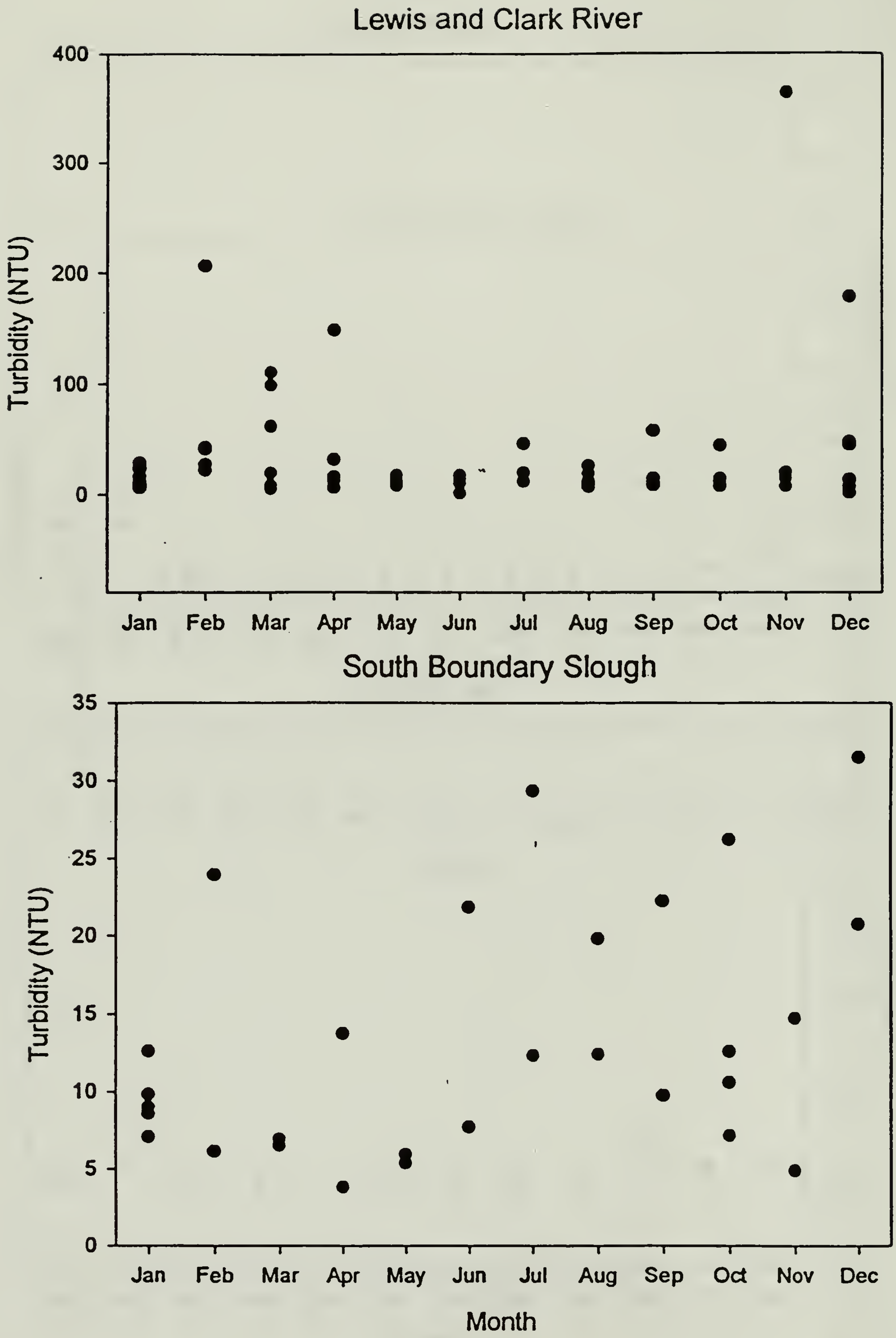


Figure 6. Monthly turbidities of the Lewis and Clark River and South Boundary Slough, FOCL.

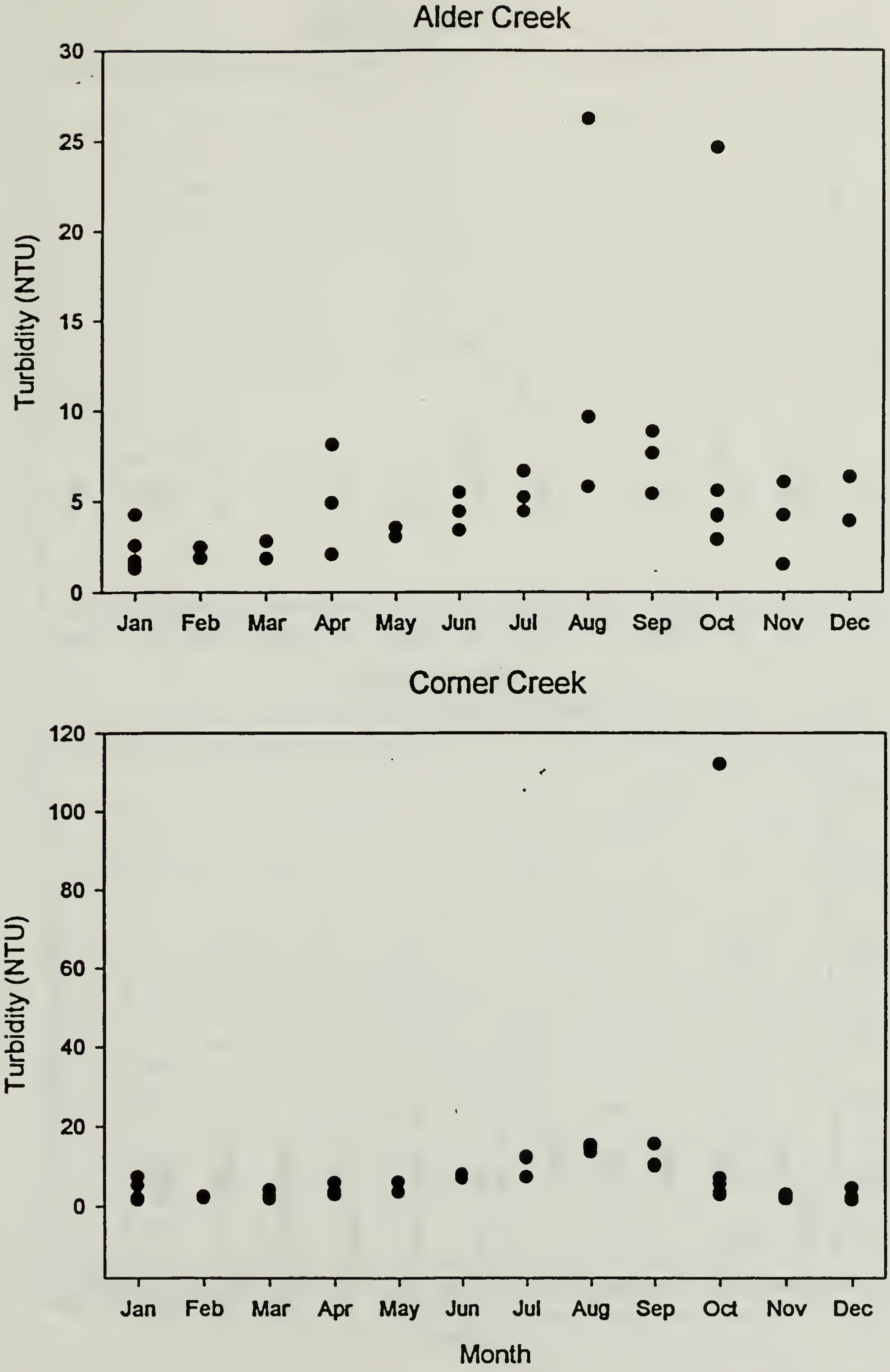


Figure 7. Monthly turbities of Alder Creek and Corner Creek, FOCL.

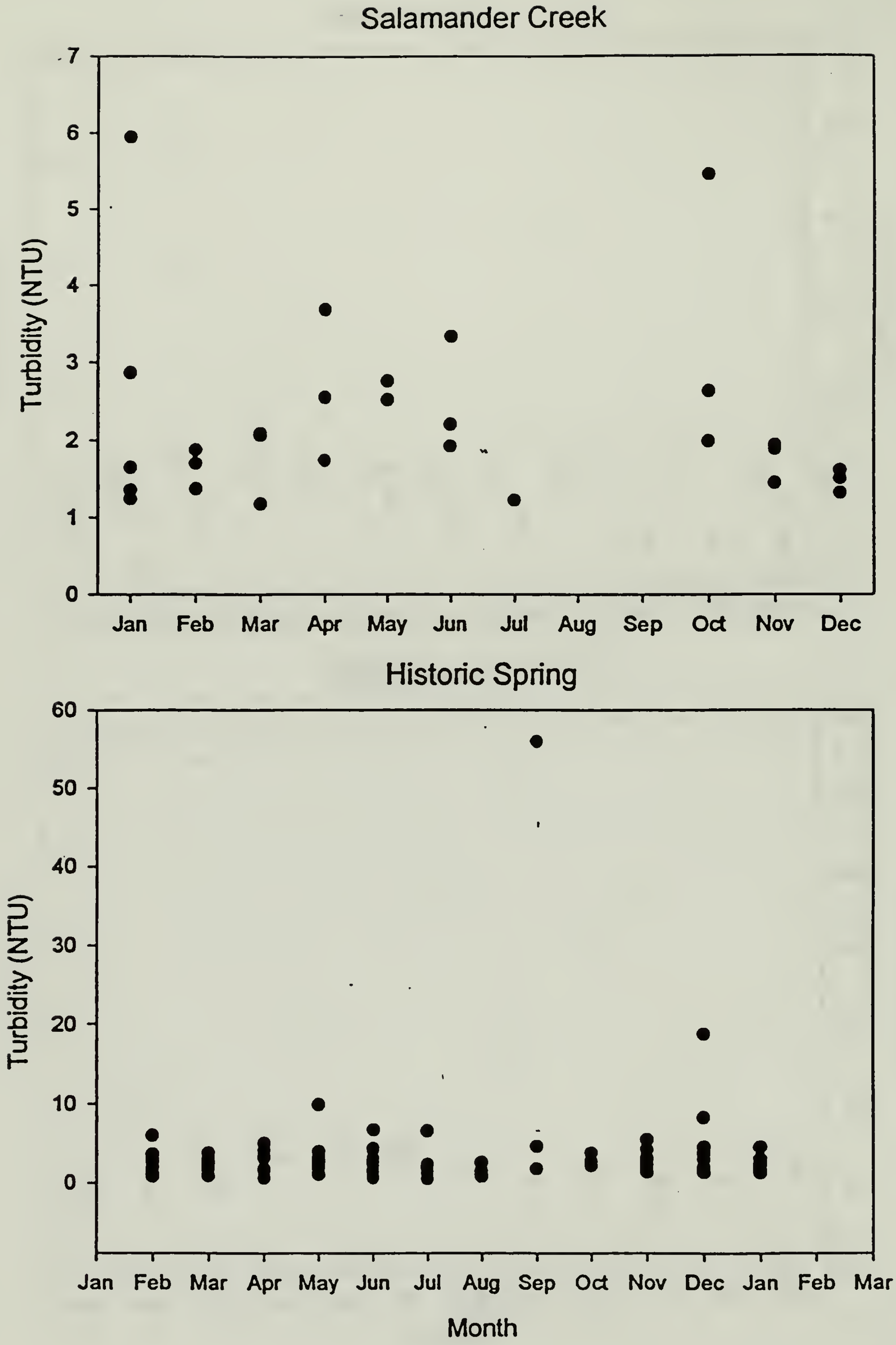


Figure 8. Monthly turbidities of Salamander Creek and Historic Spring, FOCL.

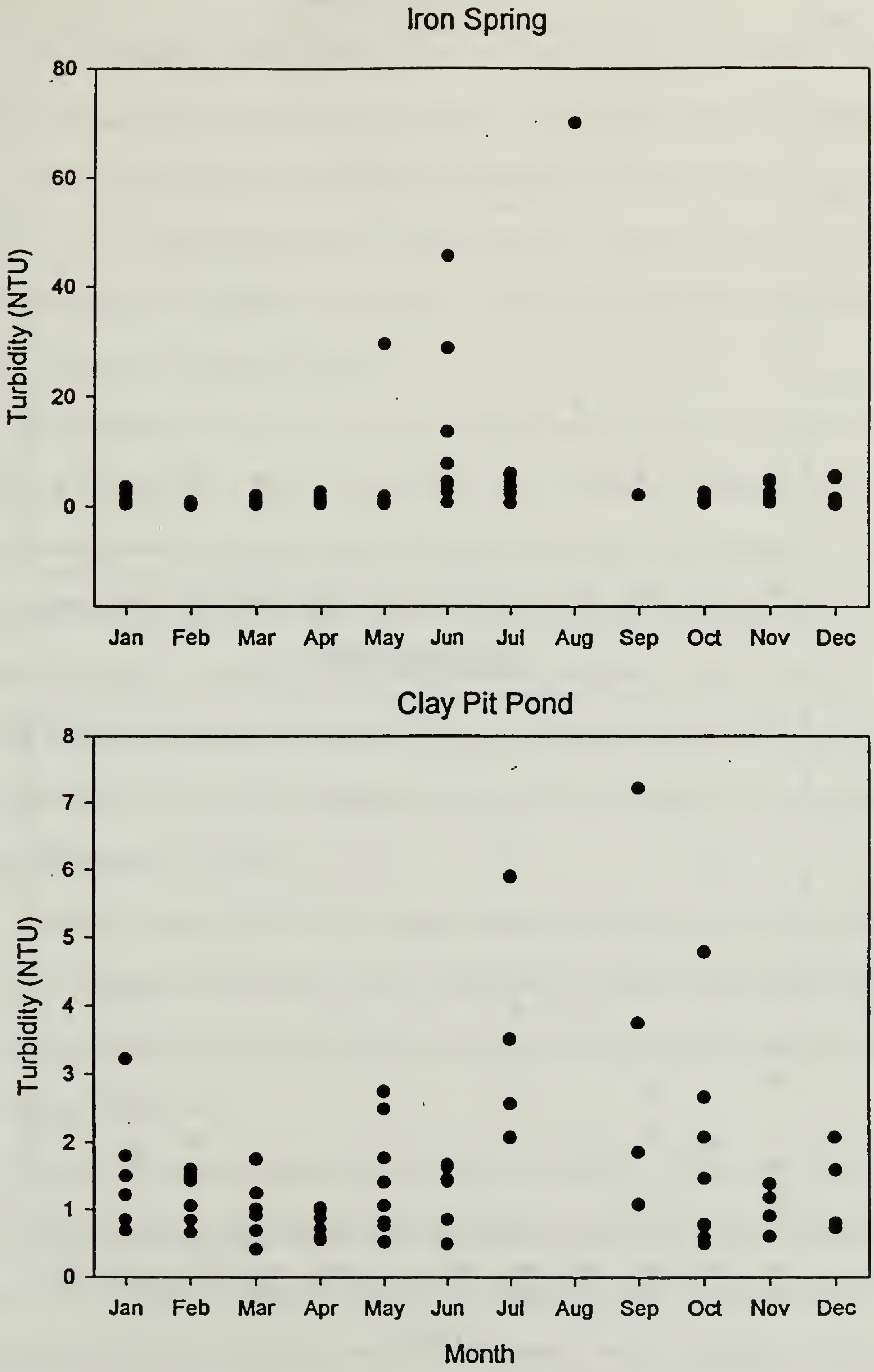


Figure 9. Monthly turbidites of Iron Spring and Clay Pit Pond, FOCL.

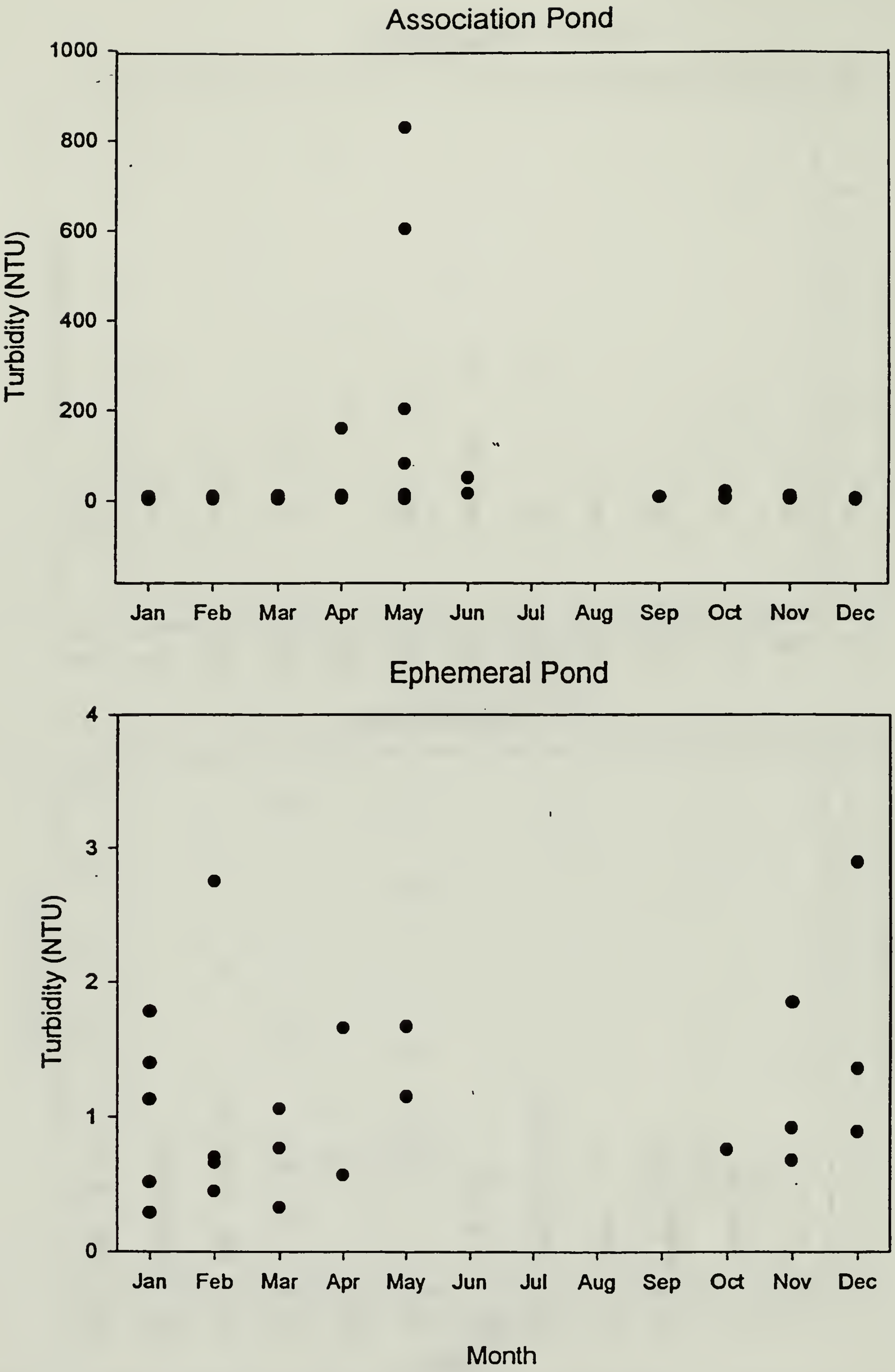


Figure 10. Monthly turbidites of Association Pond and Ephemeral Pond, FOCL.

(Figs. 11-15). Temperatures were lowest in winter and highest in summer. The typical lowest temperatures ranged from 5 to 10 °C. LECL and SBSL had the highest water temperatures in summer (20.0 - 23.5 °C), whereas the highest values for the other sites collectively ranged from about 12 to 16 °C. Considerable variation in water temperature by month was observed at each study site. The average temperatures and minimum - maximum temperatures for each site by month are shown in the Appendix (Table 21).

pH: Considerable variation was observed in the temporal changes of pH among the study sites (Figs. 16-20). At LECL, pH was lowest during winter and highest in summer. Similar seasonal patterns were observed at CLPO, IRSP, and COCR. For ASPO, however, pH values were highest in winter and then decreased as the pond dried and remained low during the early phases of fall recharge. At HISP, pH values were variable during most months, with the exception of summer months. Little seasonal changes of pH were observed at SBSL, ALCR, EPPO, and SACR. Average pH and minimum-maximum pH for each study site by month are shown in the Appendix (Table 22).

Alkalinity: Except for ASPO, the alkalinity at each study site was lowest in winter and highest in summer and early fall (Figs. 21-25). The alkalinity of ASPO was variable through time. Average alkalinity and minimum-maximum values for each study site by month are shown in the Appendix (Table 23).

Conductivity: Patterns of seasonal conductivity among the study sites were variable (Figs. 26-30). At ALCR, COCR, SACR, HISP, and IRSP conductivity was lowest in winter and highest in summer to fall. Similar patterns of season changes in conductivity were observed during some years at LECL and SBSL, but not in other years. Very little seasonal changes in

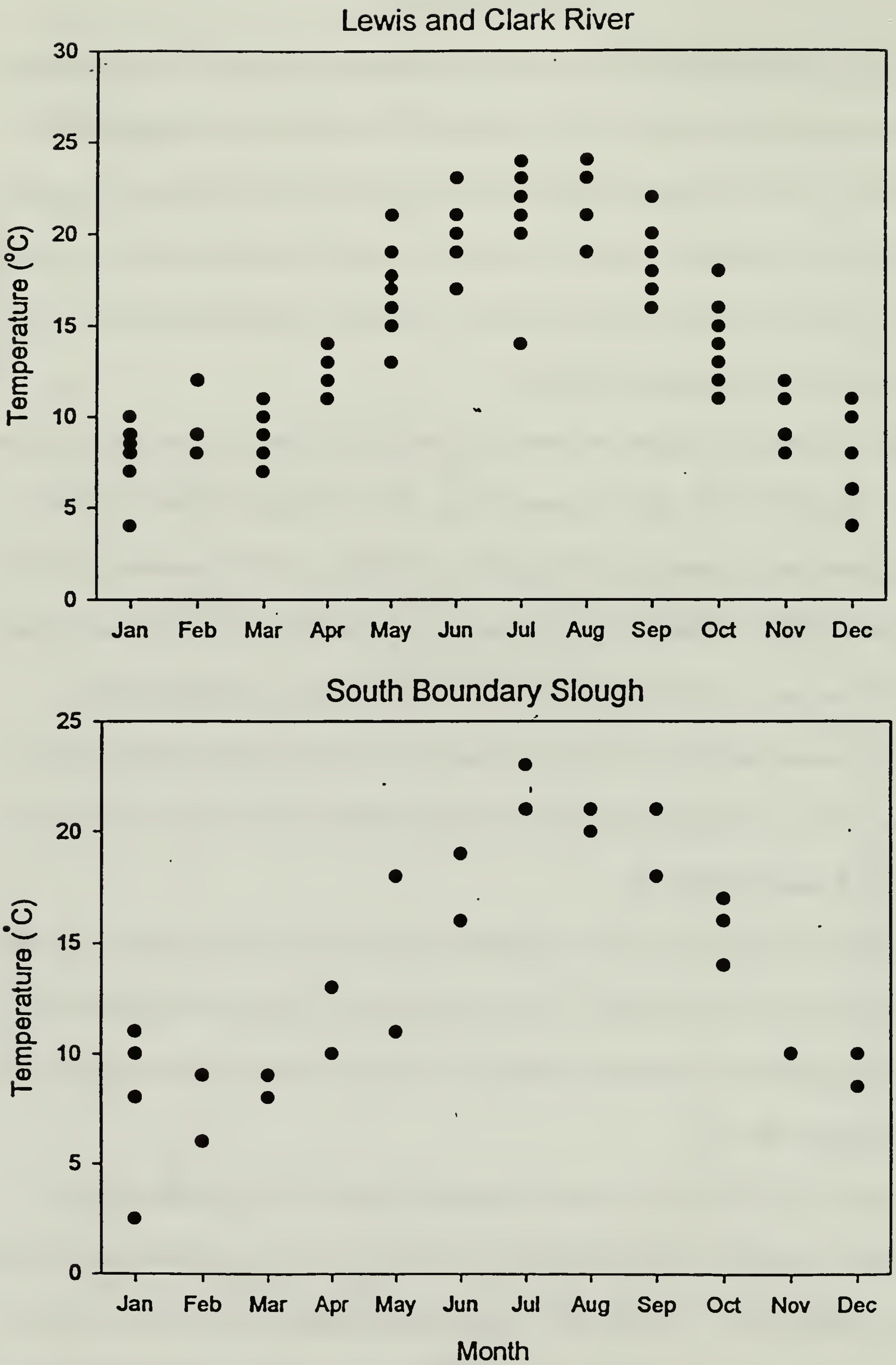


Figure 11. Monthly water temperatures of the Lewis and Clark River and South Boundary Slough, FOCL.

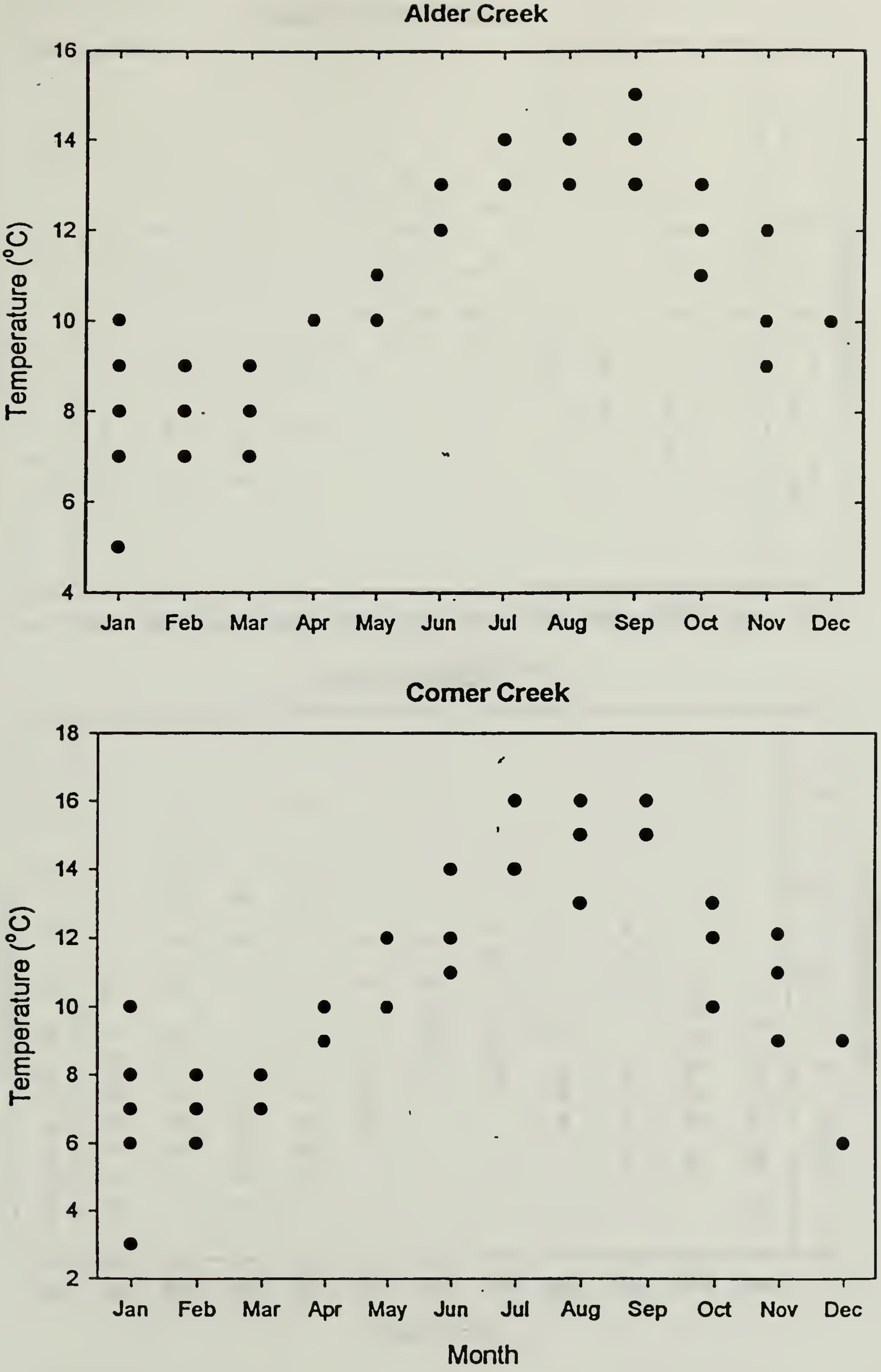


Figure 12. Monthly water temperatures of Alder Creek and Corner Creek, FOCL.

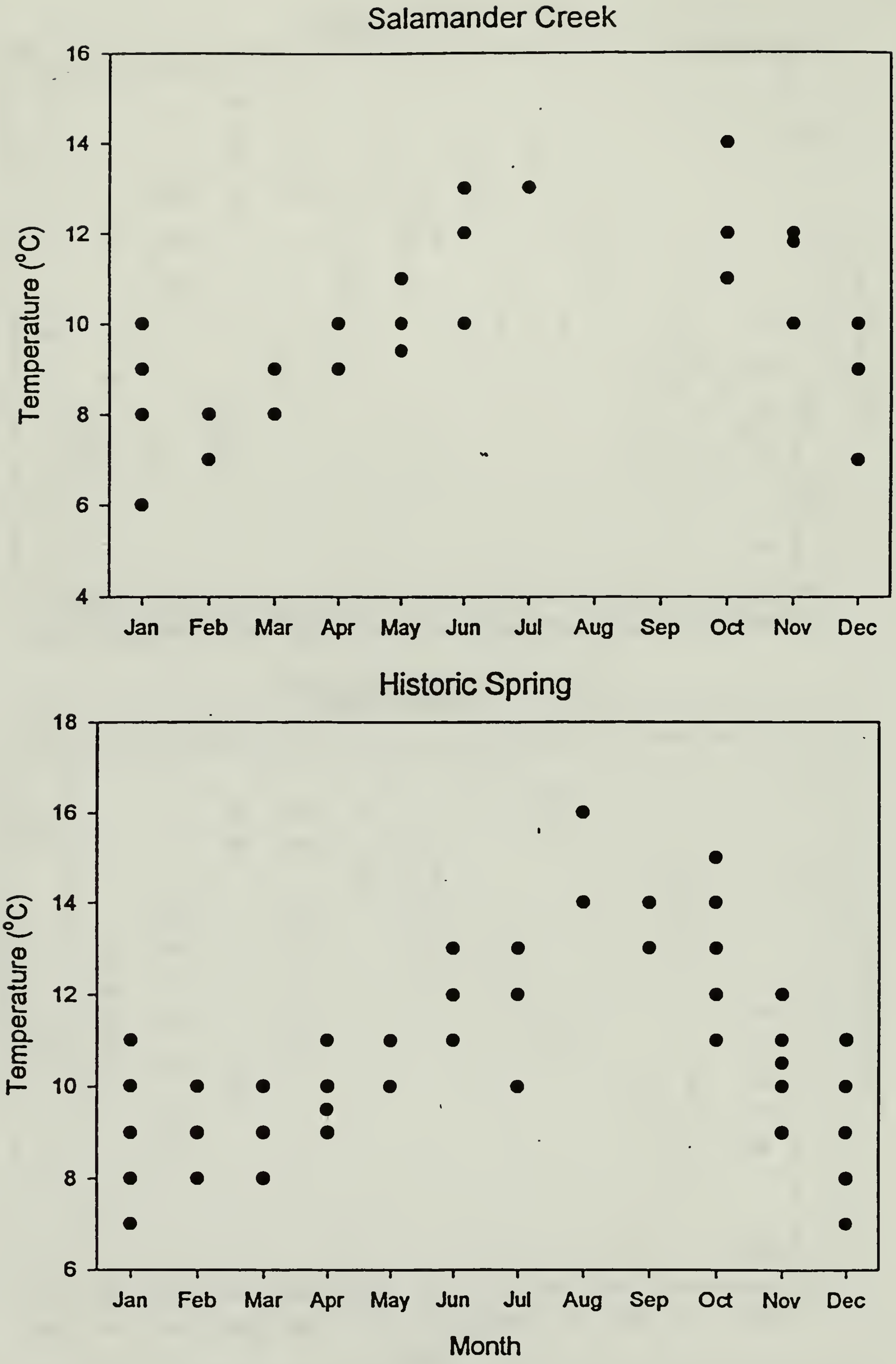


Figure 13. Monthly water temperatures of Salamander Creek and Historic Spring, FOCL.

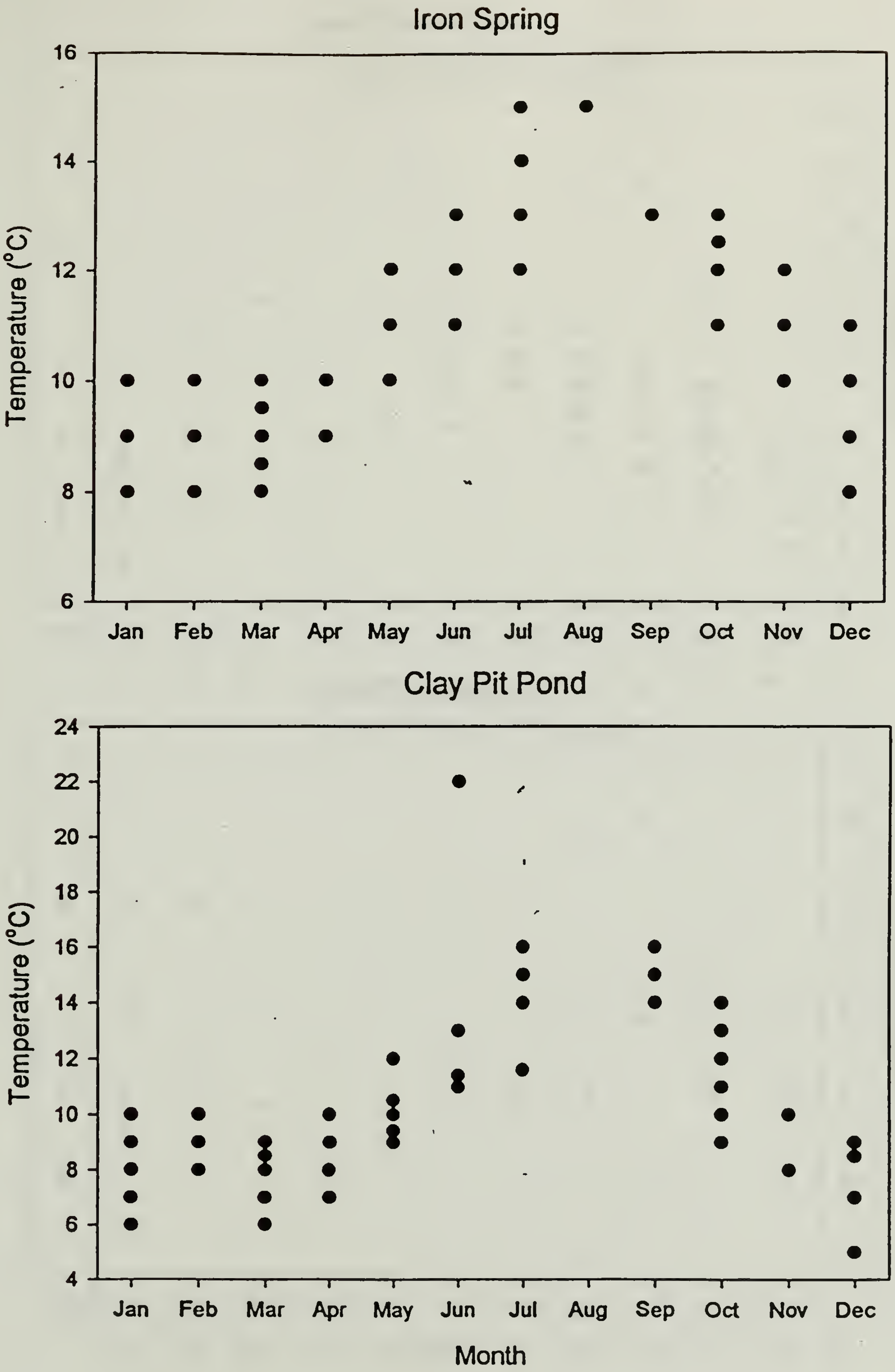
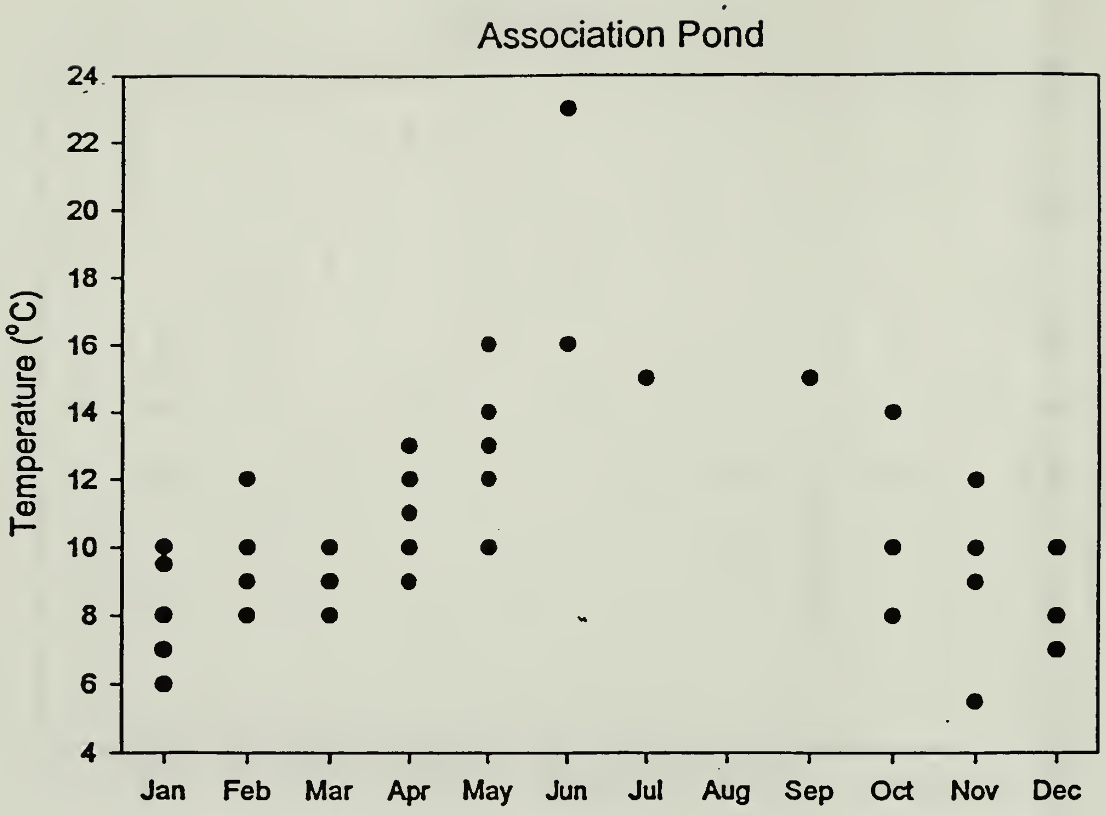


Figure 14. Monthly water temperatures of Iron Spring and Clay Pit Pond, FOCL.



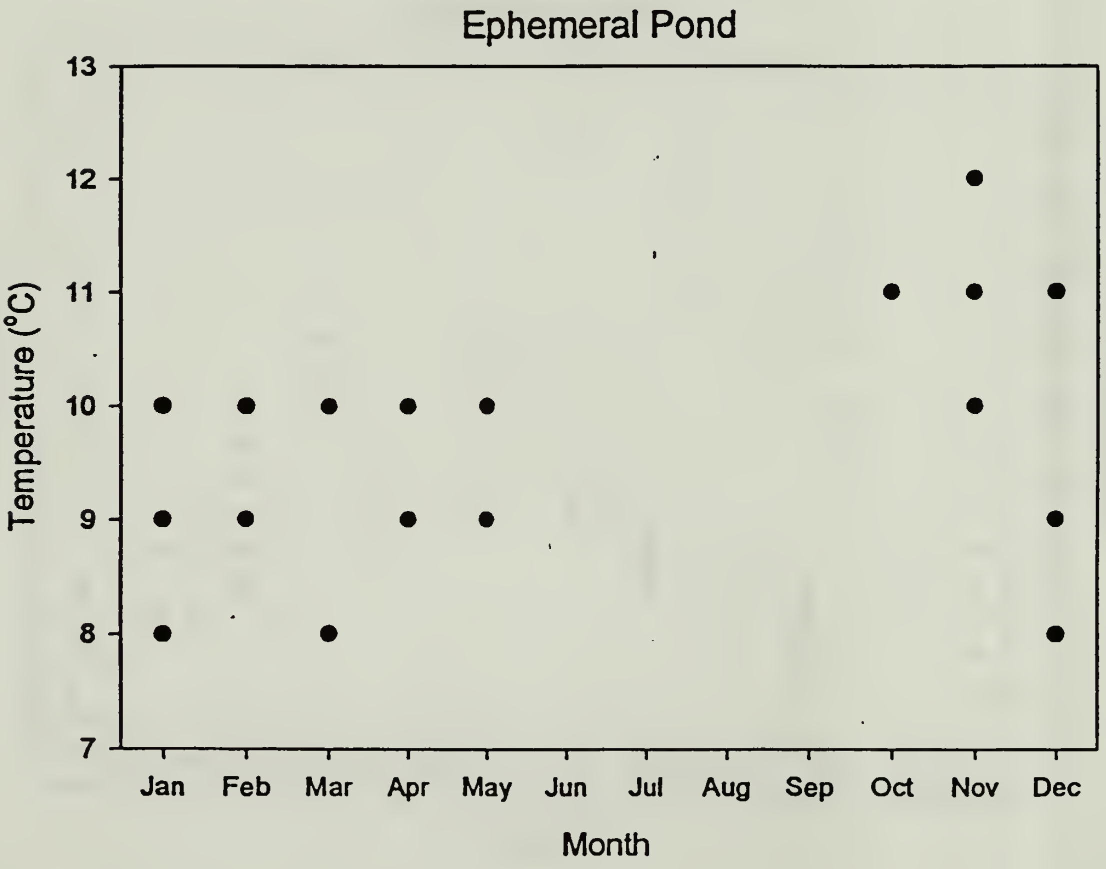


Figure 15. Monthly water temperatures of Association Pond and Ephemeral Pond, FOCL.

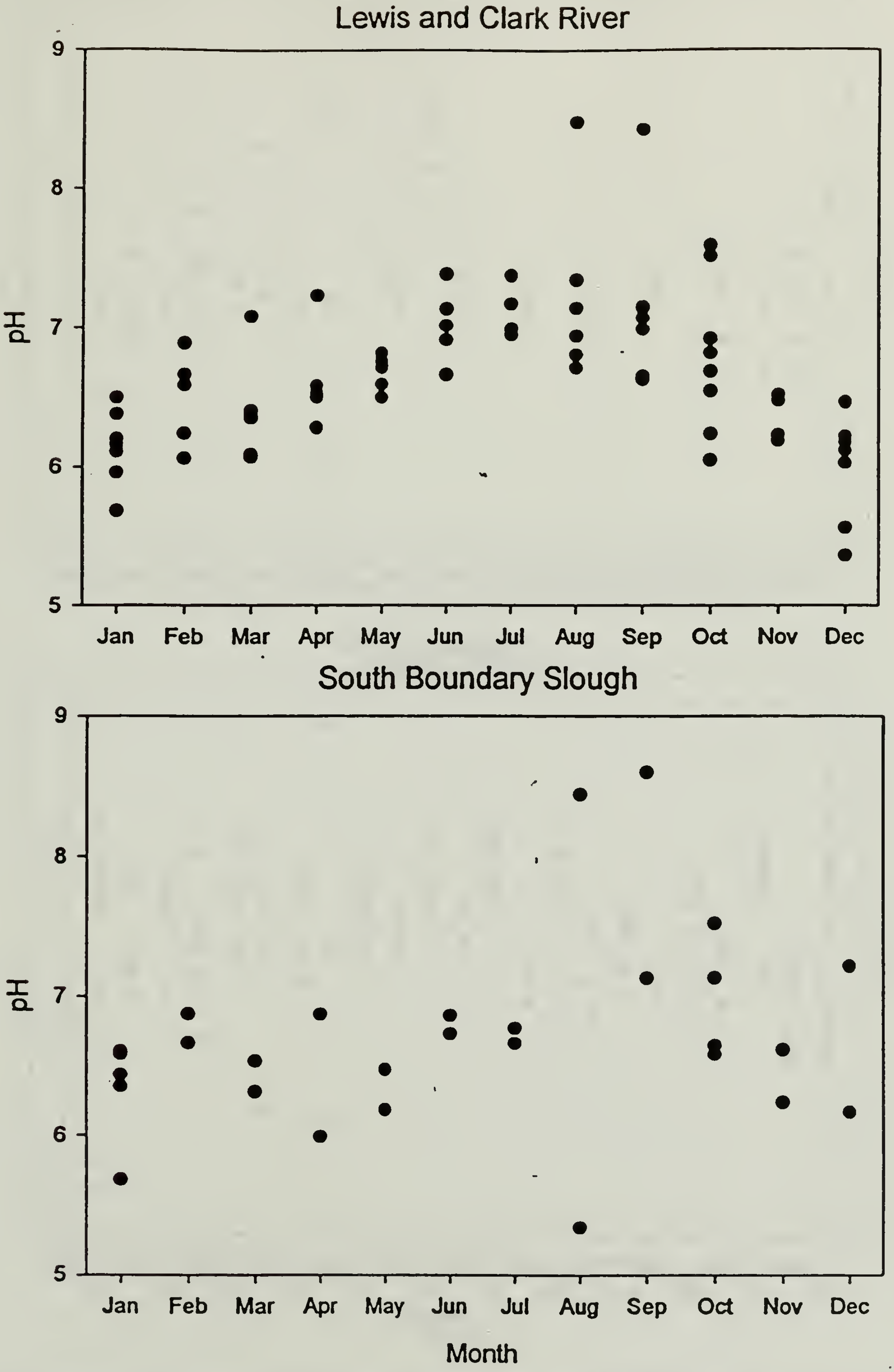


Figure 16. Monthly pH of the Lewis and Clark River and South Boundary Slough, FOCL.

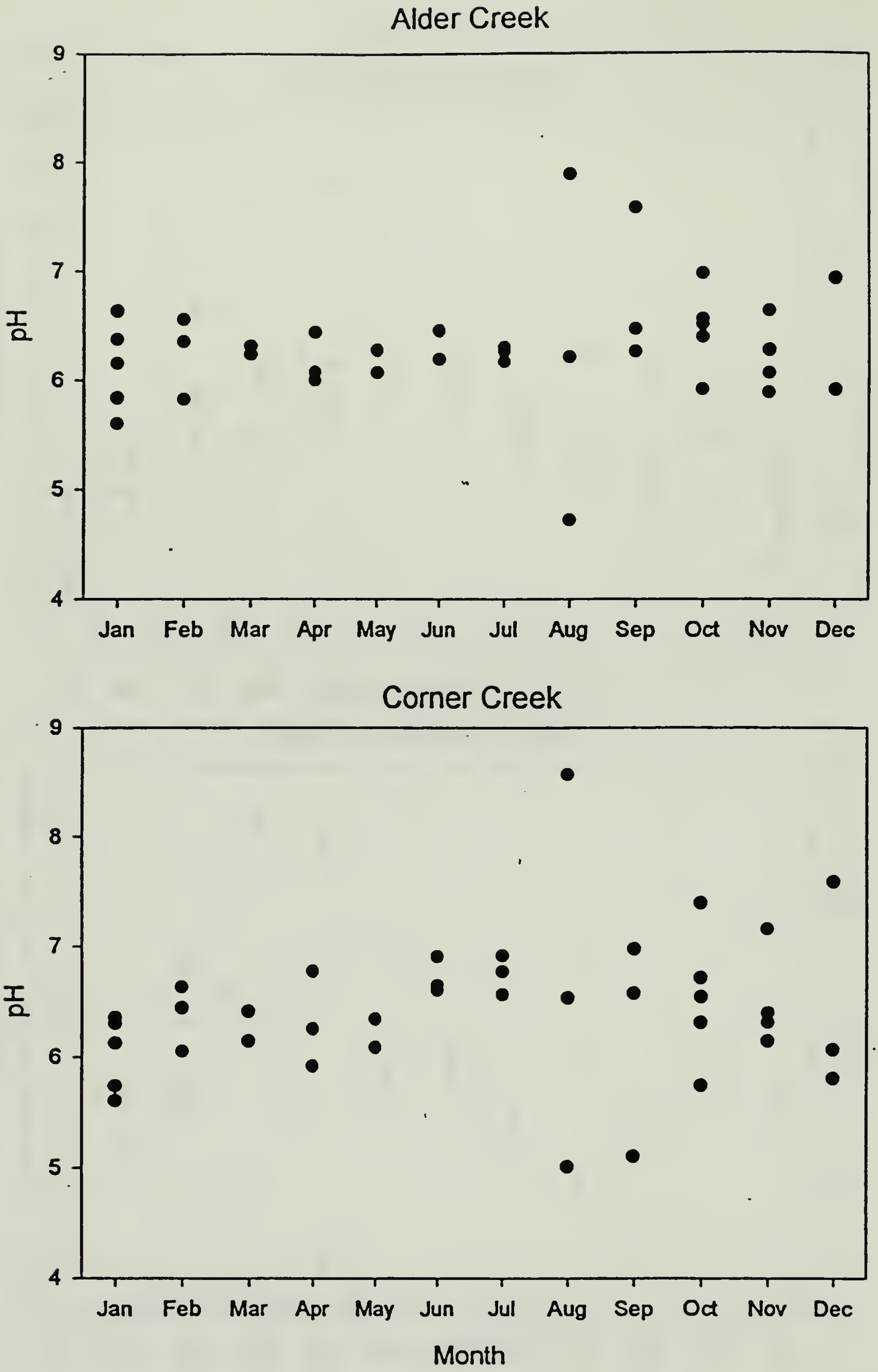


Figure 17. Monthly pH of Alder Creek and Corner Creek, FOCL.

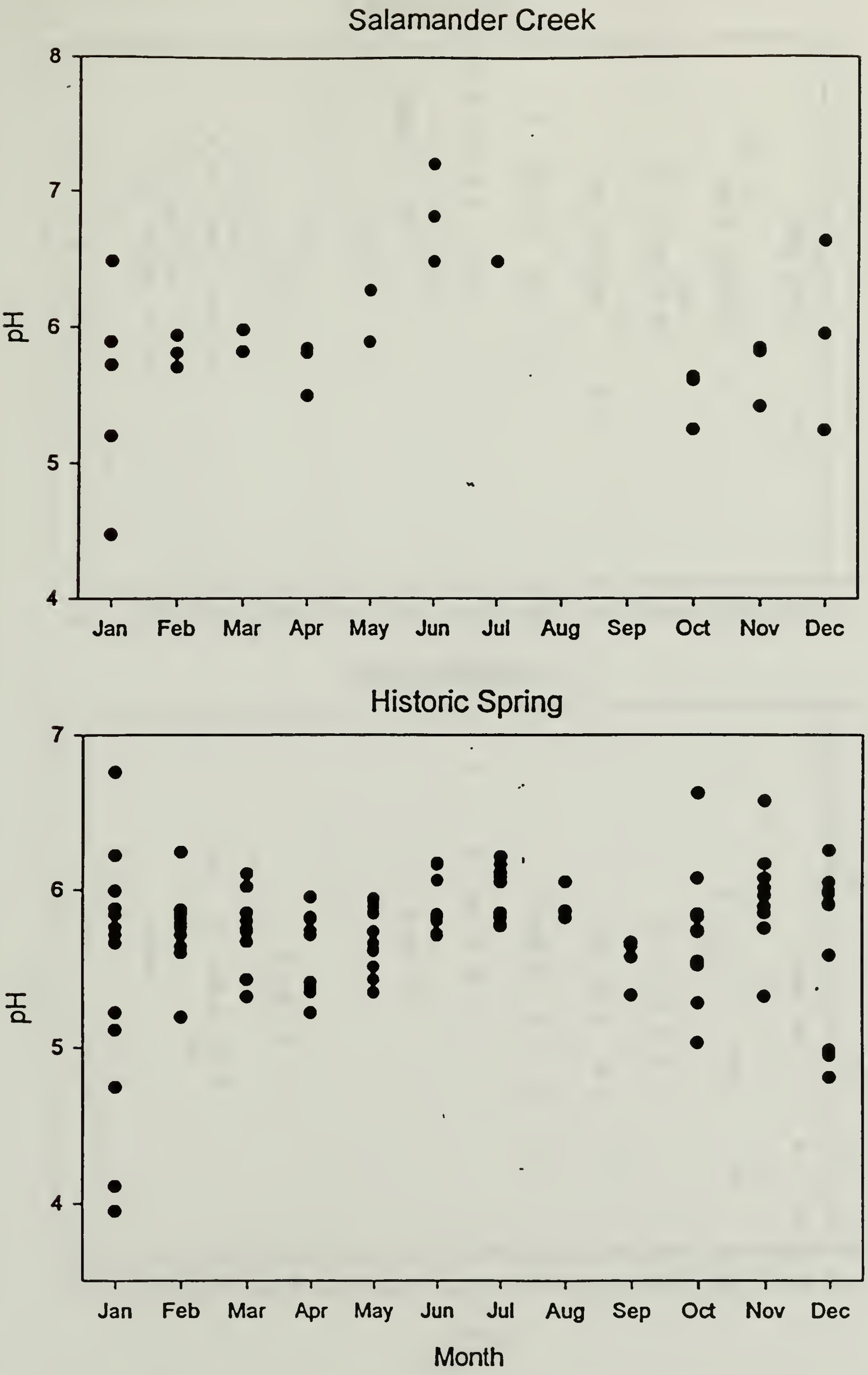


Figure 18. Monthly pH of Salamander Creek and Historic Spring, FOCL.

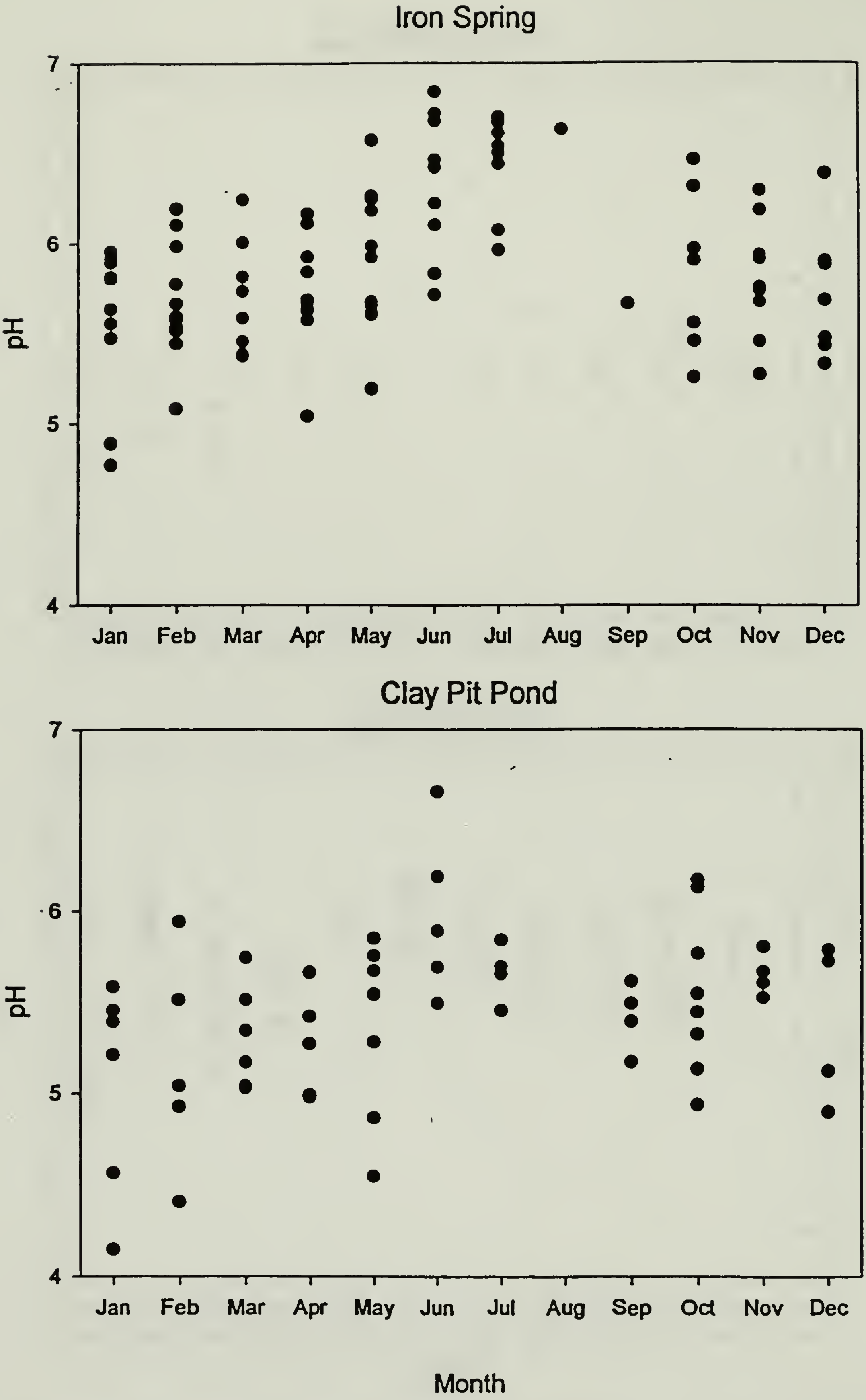
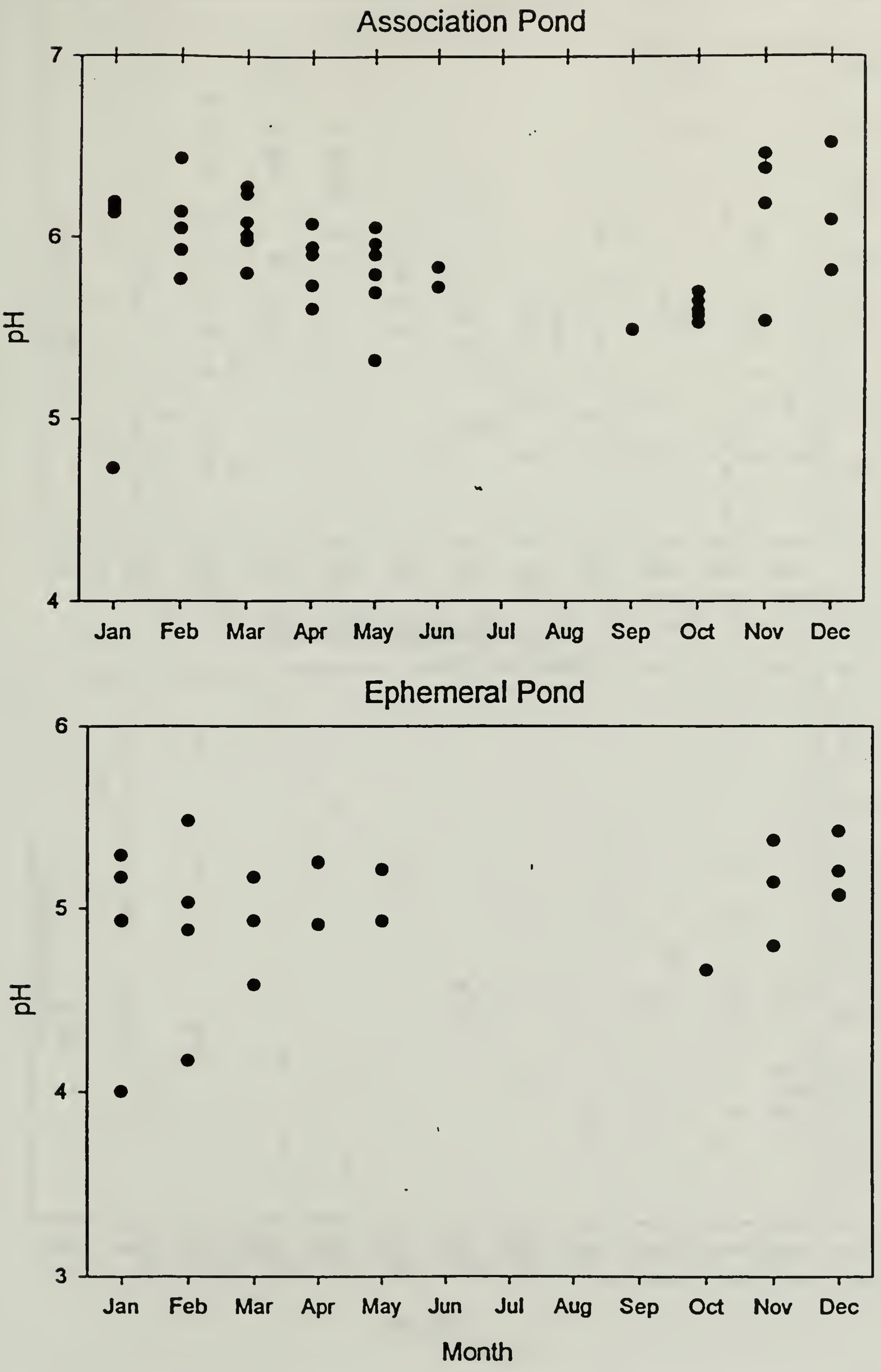


Figure 19. Monthly pH of Iron Spring and Clay Pit Pond, FOCL.



gure 20. Monthly pH of Association Pond and Ephemeral Pond, FOCL.

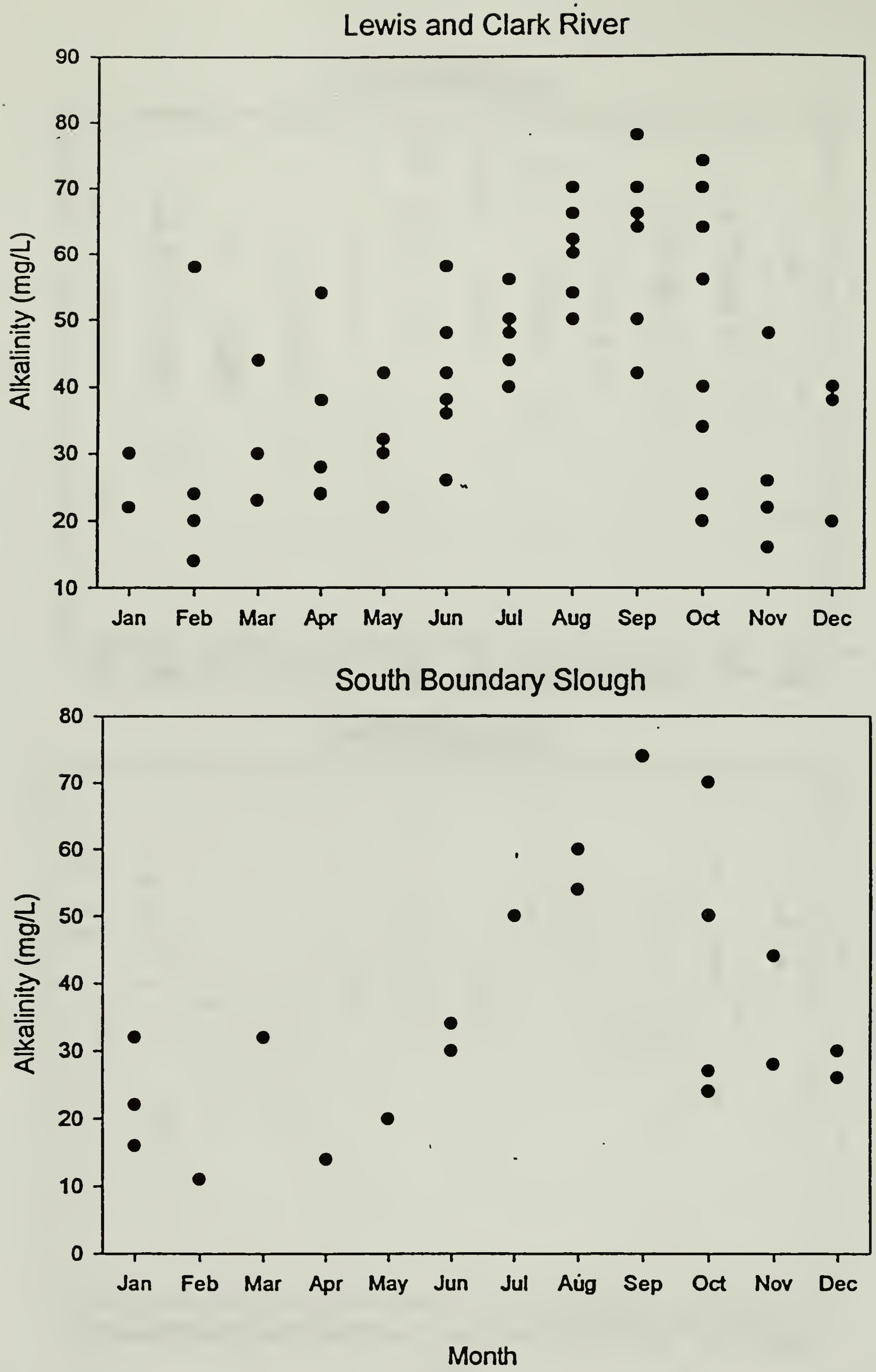


Figure 21. Monthly alkalinities of the Lewis and Clark River and South Boundary Slough, FOCL.

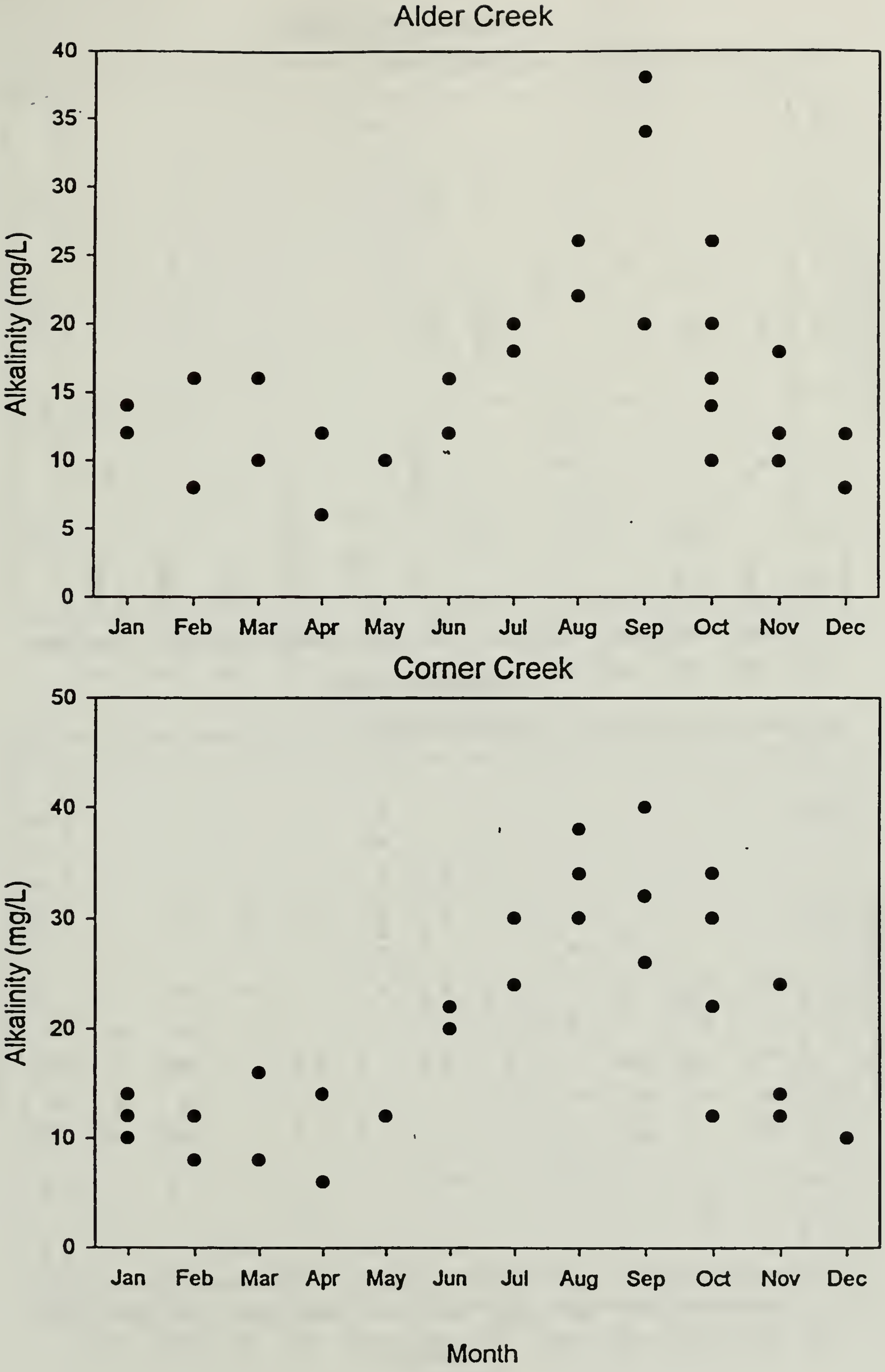


Figure 22. Monthly alkalinities of Alder Creek and Corner Creek, FOCL.

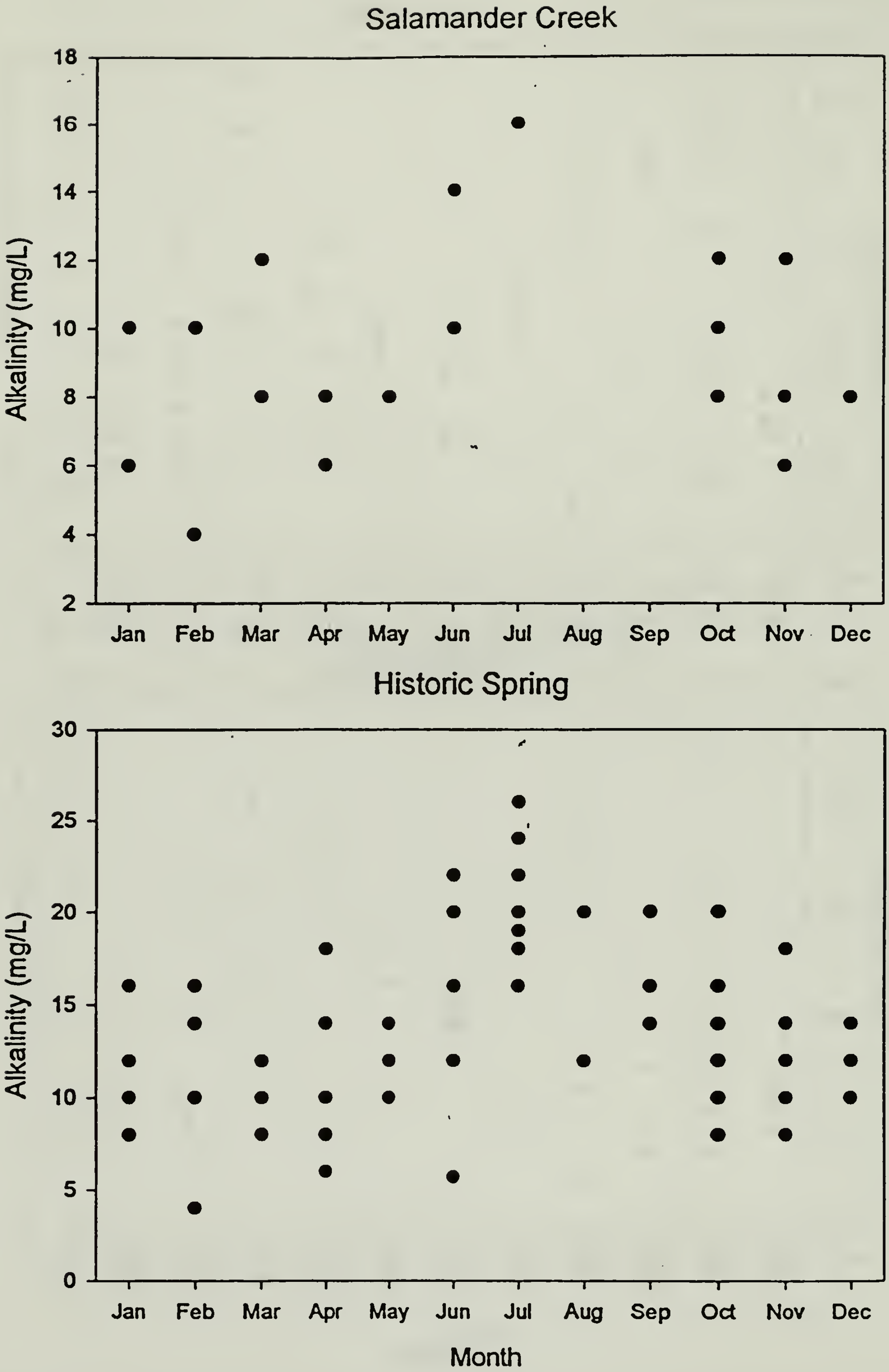


Figure 23. Monthly alkalinities of Salamander Creek and Historic Spring, FOCL.

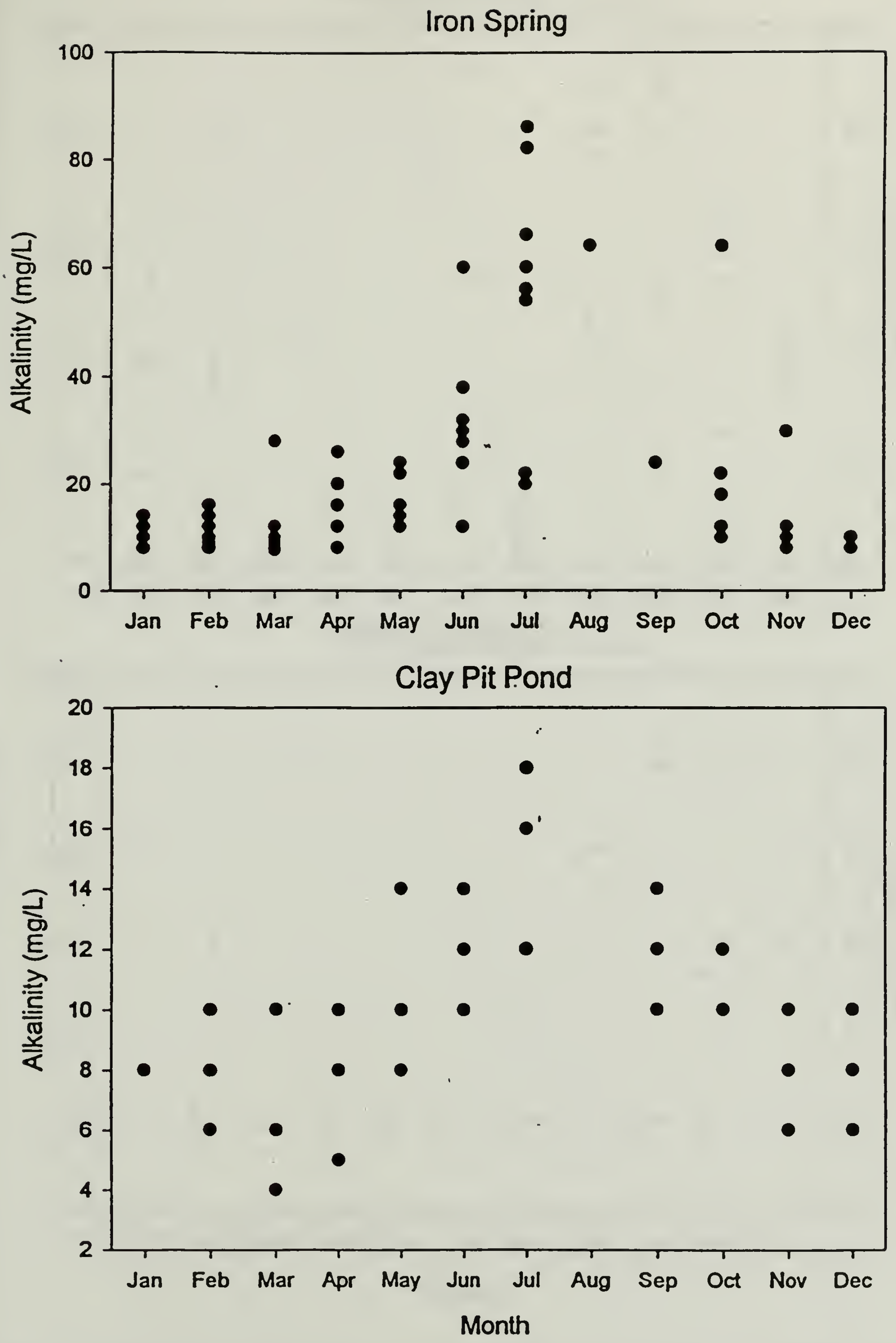


Figure 24. Monthly alkalinities of Iron Spring and Clay Pit Pond, FOCL.

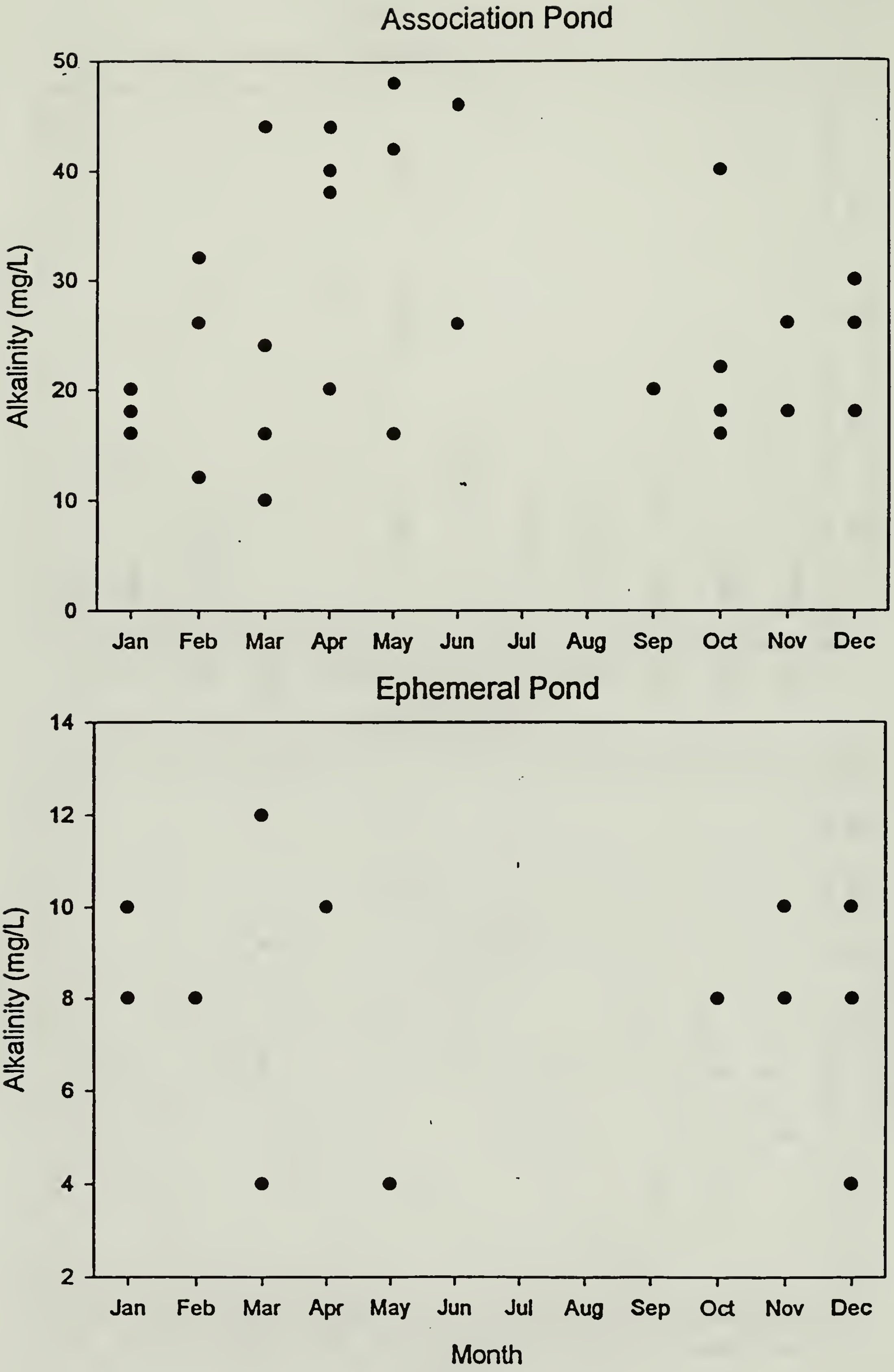


Figure 25. Monthly alkalinities of Association Pond and Ephemeral Pond, FOCL.

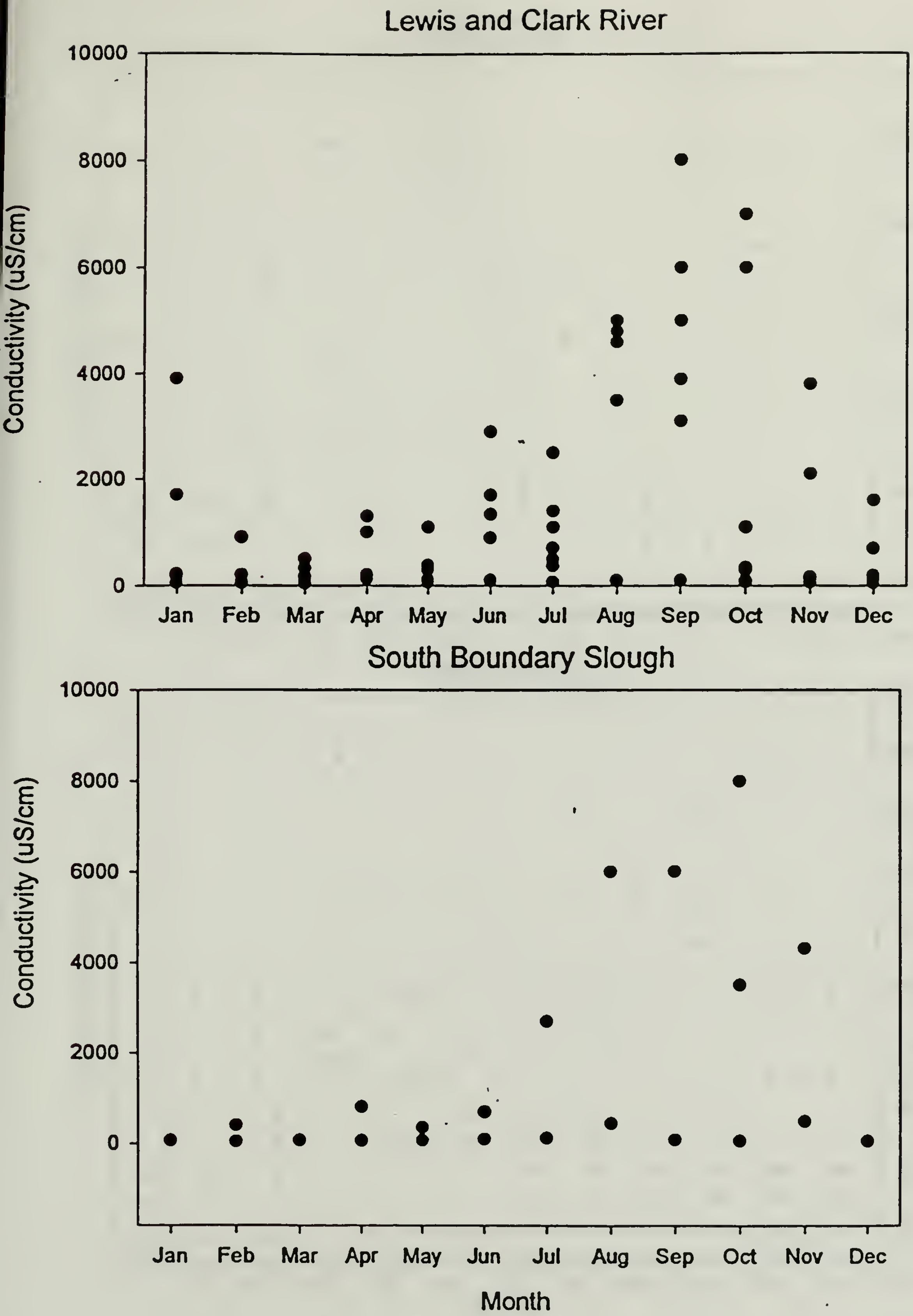


Figure 26. Monthly conductivities of the Lewis and Clark River and South Boundary Slough, FOCL.

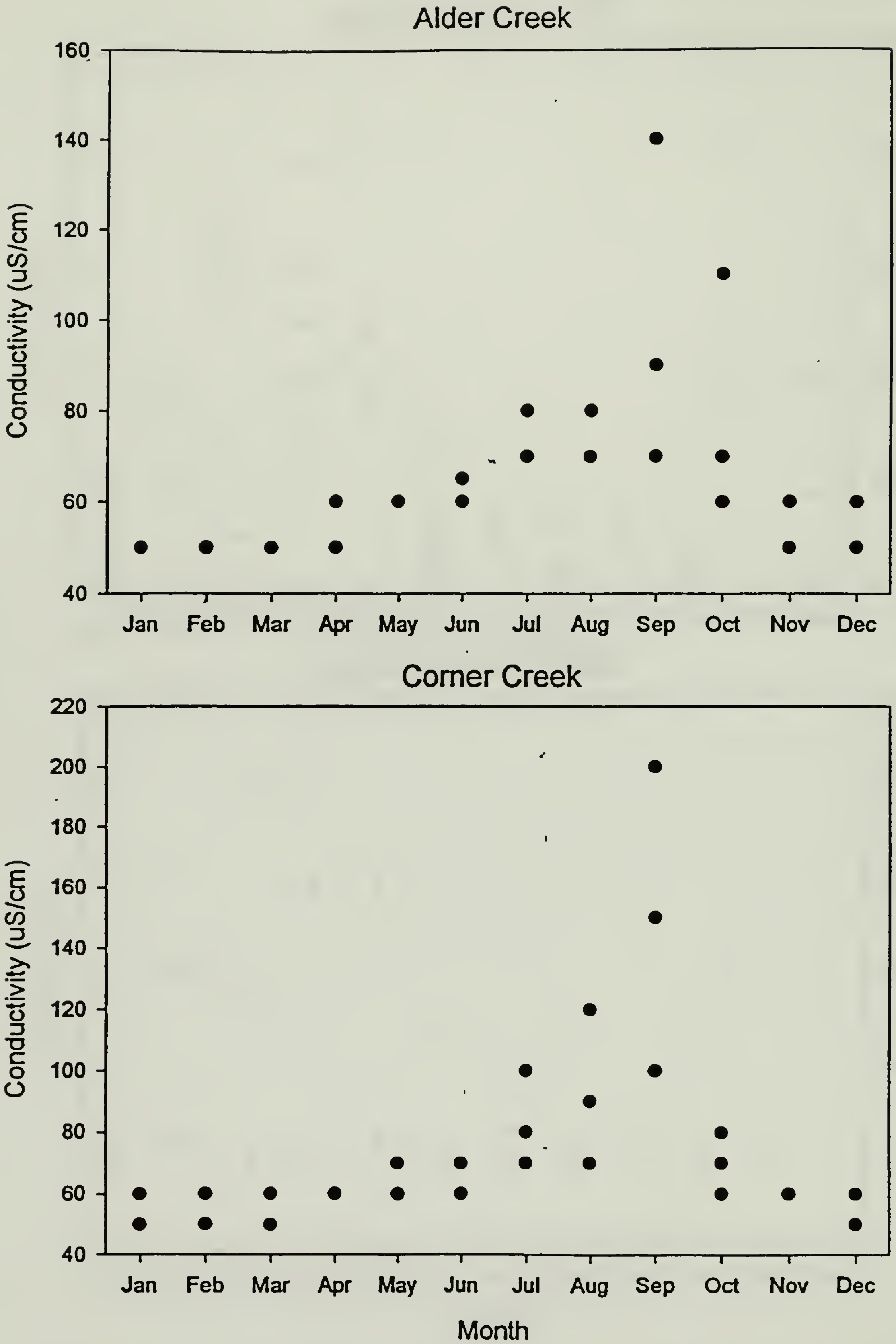


Figure 27. Monthly conductivities of Alder Creek and Corner Creek, FOCL.

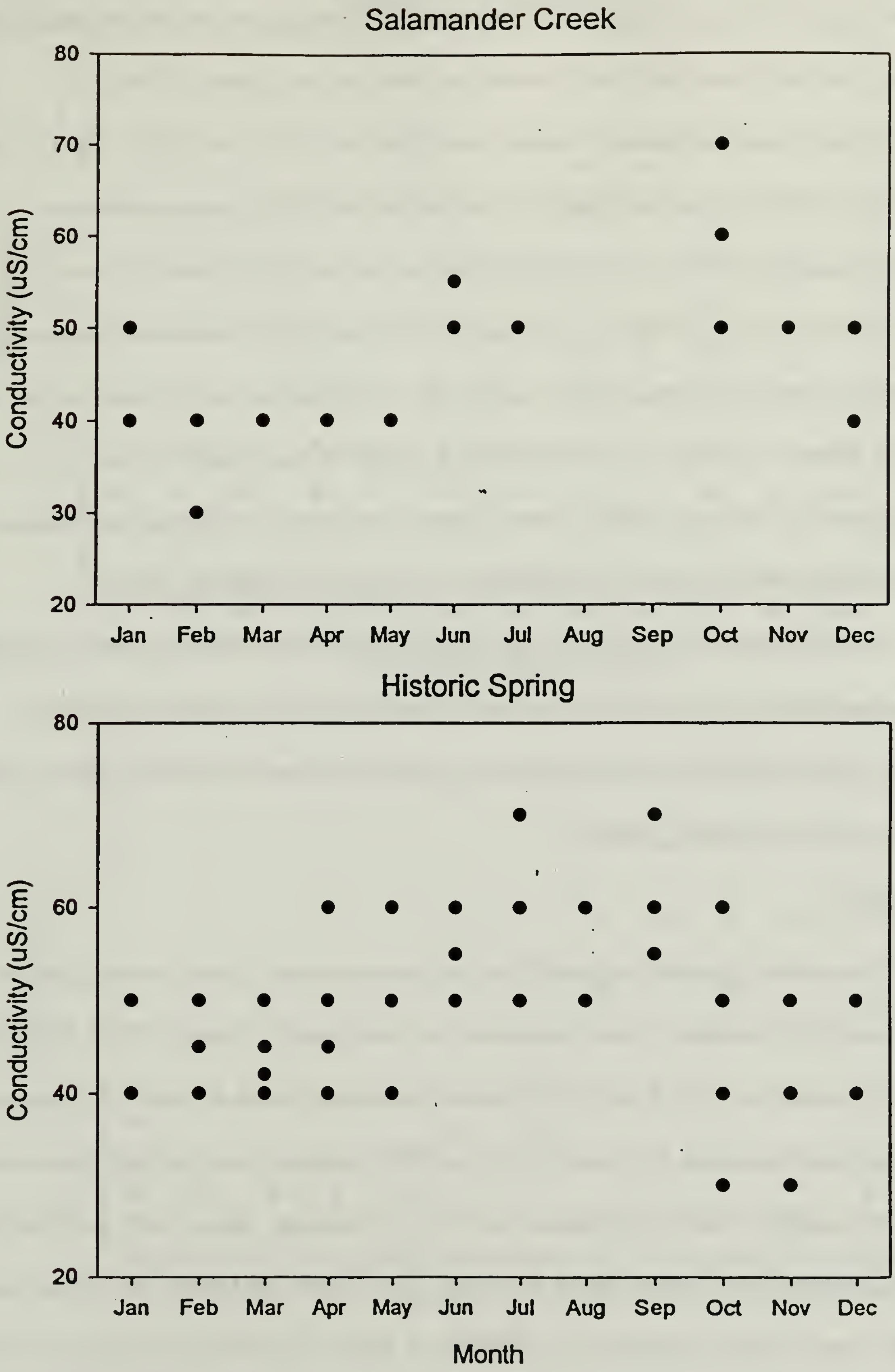


Figure 28. Monthly conductivities of Salamander Creek and Historic Spring, FOCL.

conductivity were observed at ASPO, CLPO, and EPPO. Average conductivity and minimum-maximum values for each study site by month are shown in the Appendix (Table 24).

Salinity: Seasonal changes in salinity were observed at LECL and SBSL (Fig.31). The values were lowest in winter and highest in summer and early fall. Average salinity and minimum-maximum values for each site by month are shown in the Appendix (Table 25).

Dissolved Oxygen: With the exceptions of SACR and ASPO, dissolved oxygen exhibited seasonal patterns in concentration (Figs. 32-36). The concentrations were highest in winter and lowest in summer and early fall. No clear seasonal patterns in concentrations of dissolved oxyger were observed at SACR and ASPO. Average dissolved oxygen concentrations and minimum-maximum values for each study site by month are shown in the Appendix (Table 26).

With the exception of HISP, the percent saturation of dissolved oxygen did not exhibit any seasonal patterns (Fig. 37-41). The percent saturation at HISP was lowest in summer. Average percent of saturation and minimum and maximum values for each study area by month are shown in the Appendix (Table 27).

Discussion

The results of this study indicated that there is considerable diversity among the water resources of FOCL relative to water permanence and water quality. Although HISP, IRSP, and SACR were ephemeral, ALCR and COCR retained discharge through the study. The three study ponds also were ephemeral. In general, LECL (and SBSL in most cases) had the highest values for all water quality variables (temperature, salinity, pH, alkalinity, conductivity, and dissolved oxygen), whereas EPPO had the lowest. Excluding LECL, SBSL, and EPPO, the average annual range of water qualities among the study sites were as follows: (1) all had about the same water

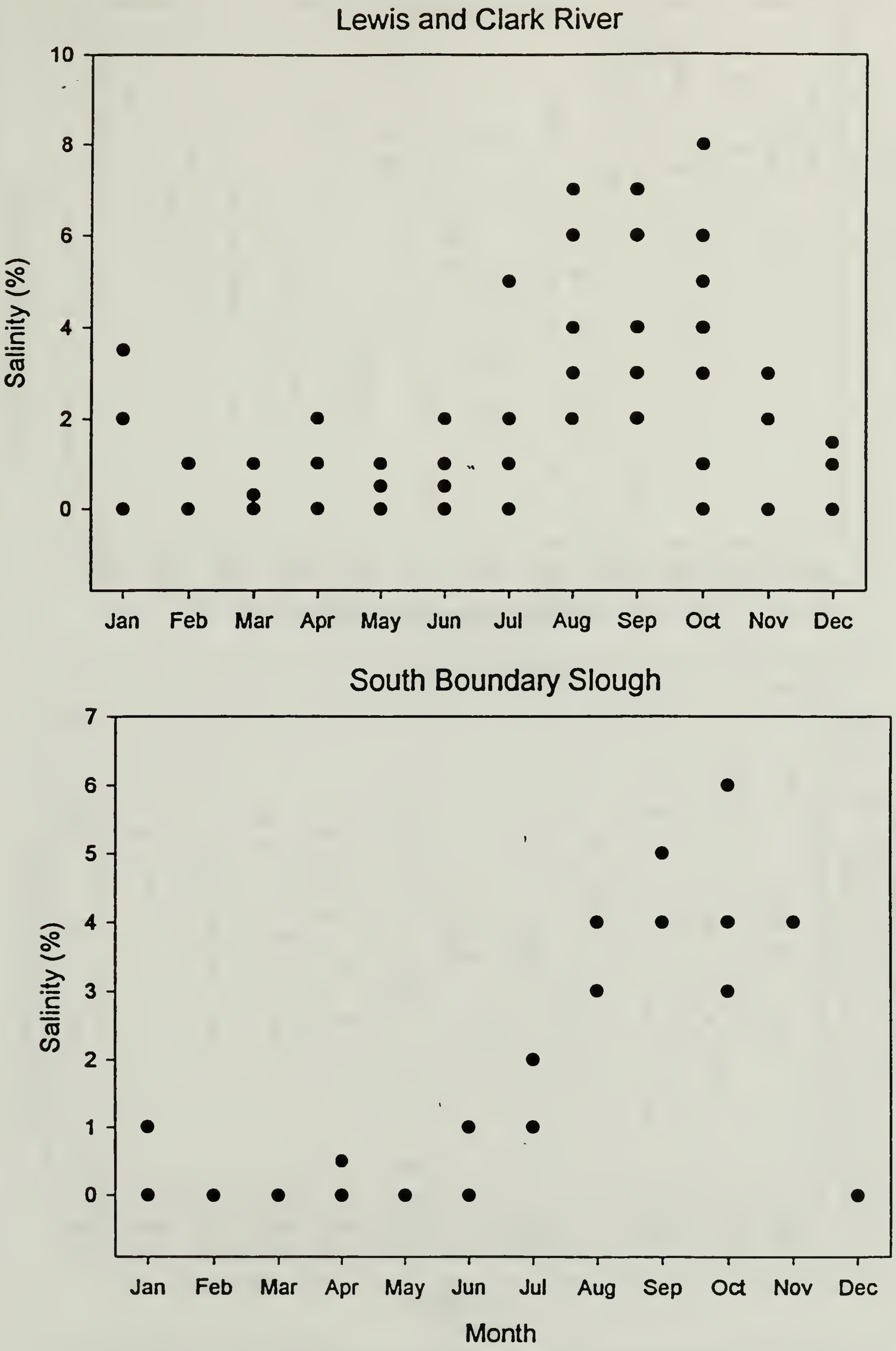


Figure 31. Monthly salinities of the Lewis and Clark River and South Boundary Slough, FOCL.

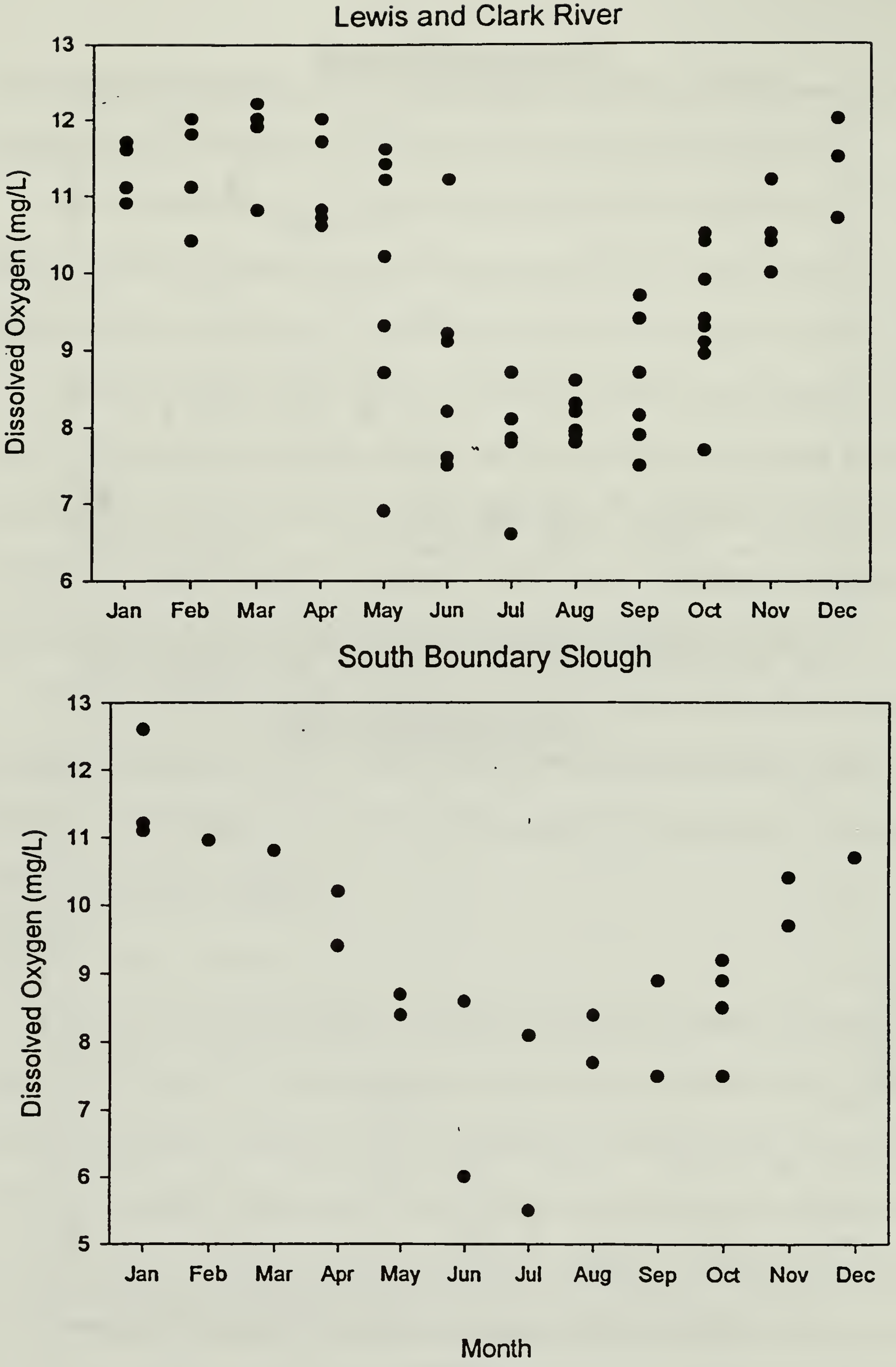


Figure 32. Monthly concentrations of dissolved oxygen of the Lewis and Clark River and South Boundary Slough, FOCL.

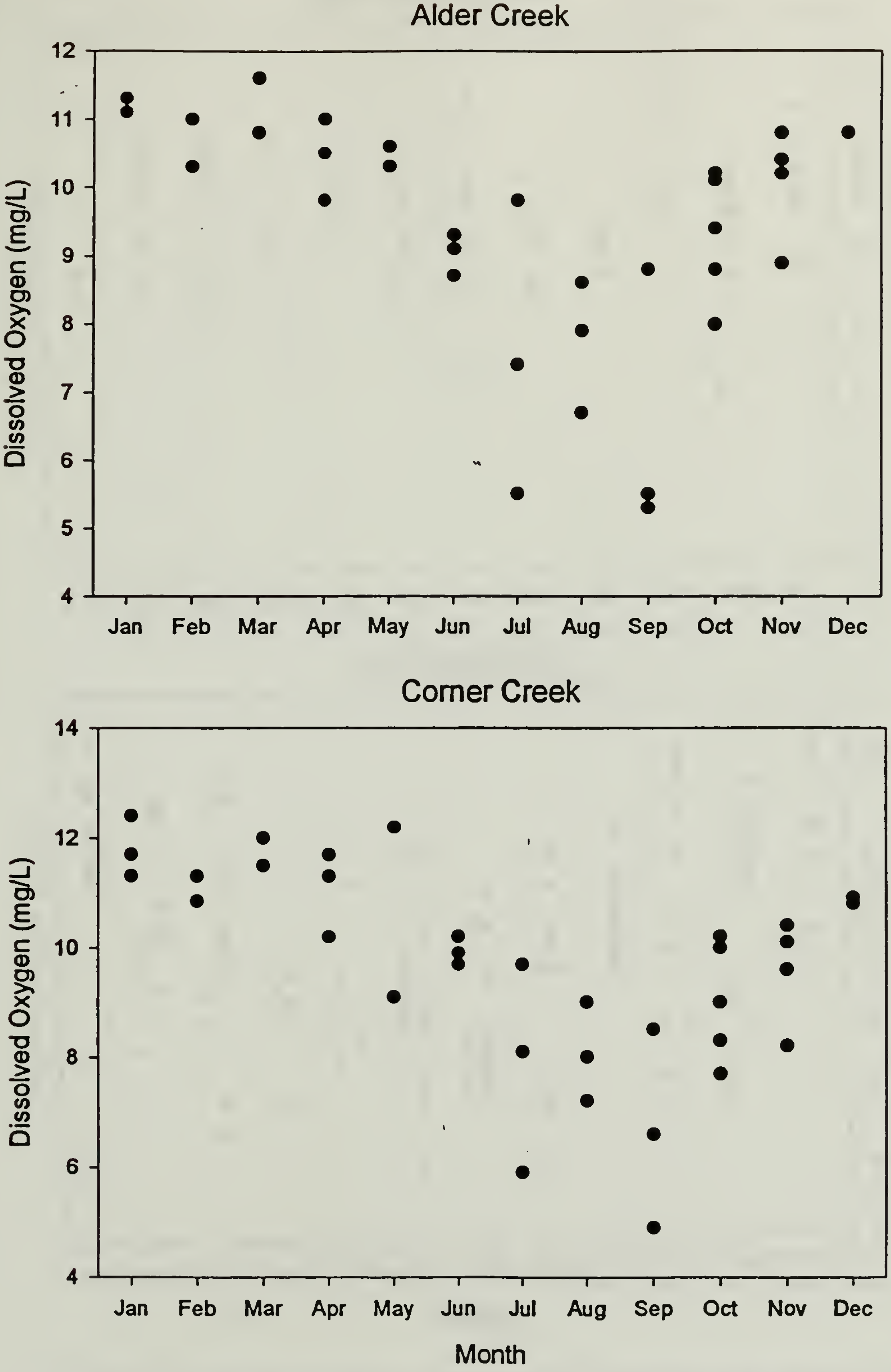
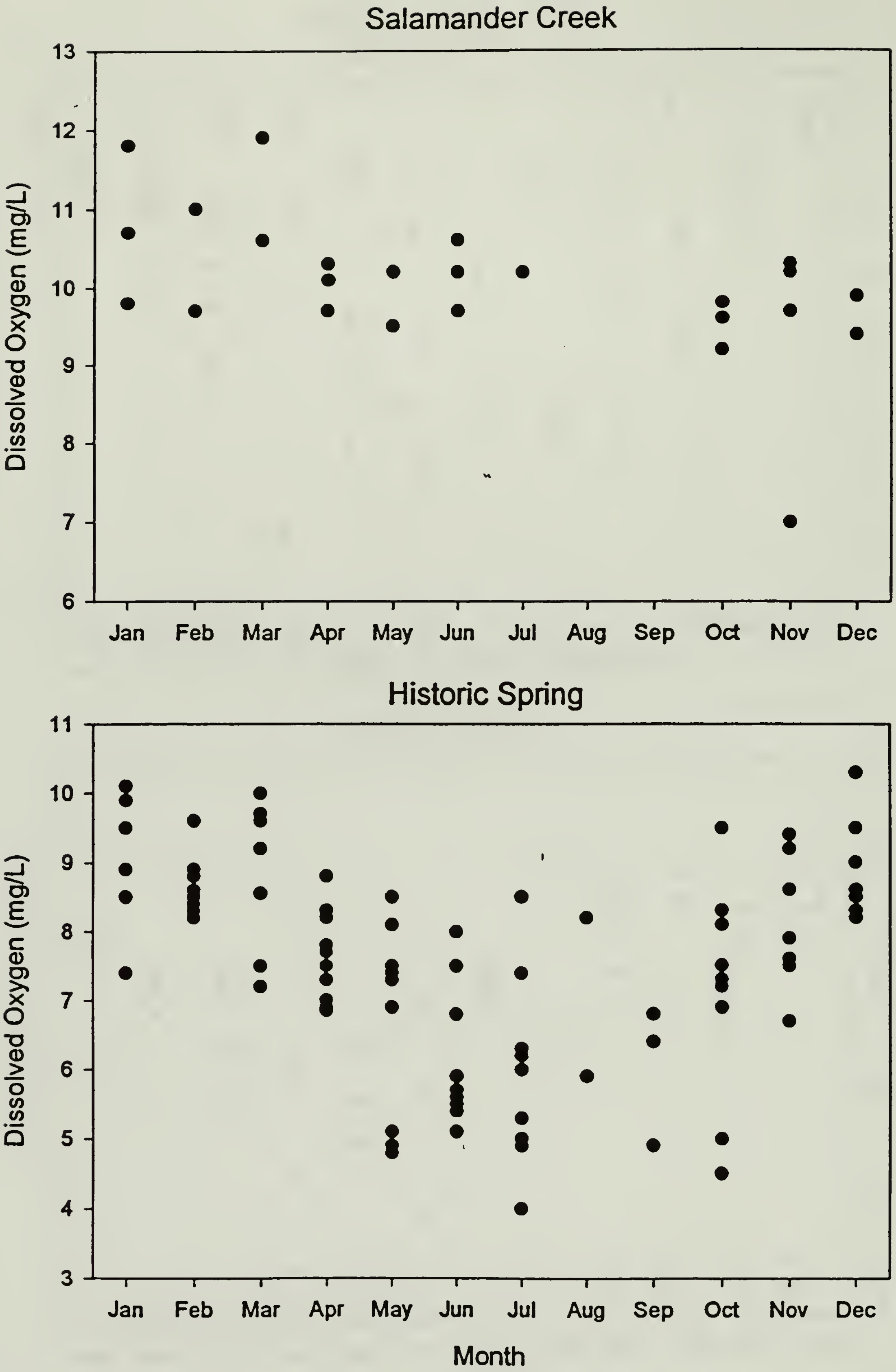
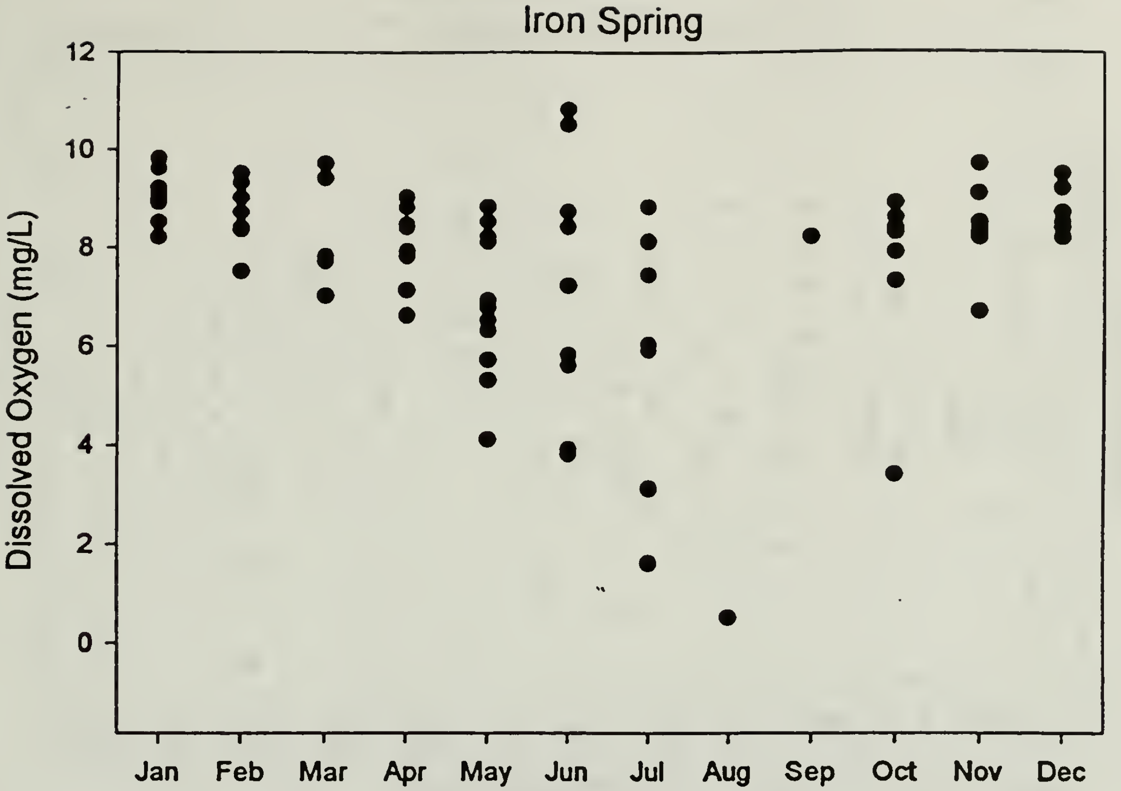


Figure 33. Monthly concentrations of dissolved oxygen of Alder Creek and Corner Creek, FOCL.



igure 34. Monthly concentrations of dissolved oxygen of Salamander Creek and Historic Spring, FOCL.



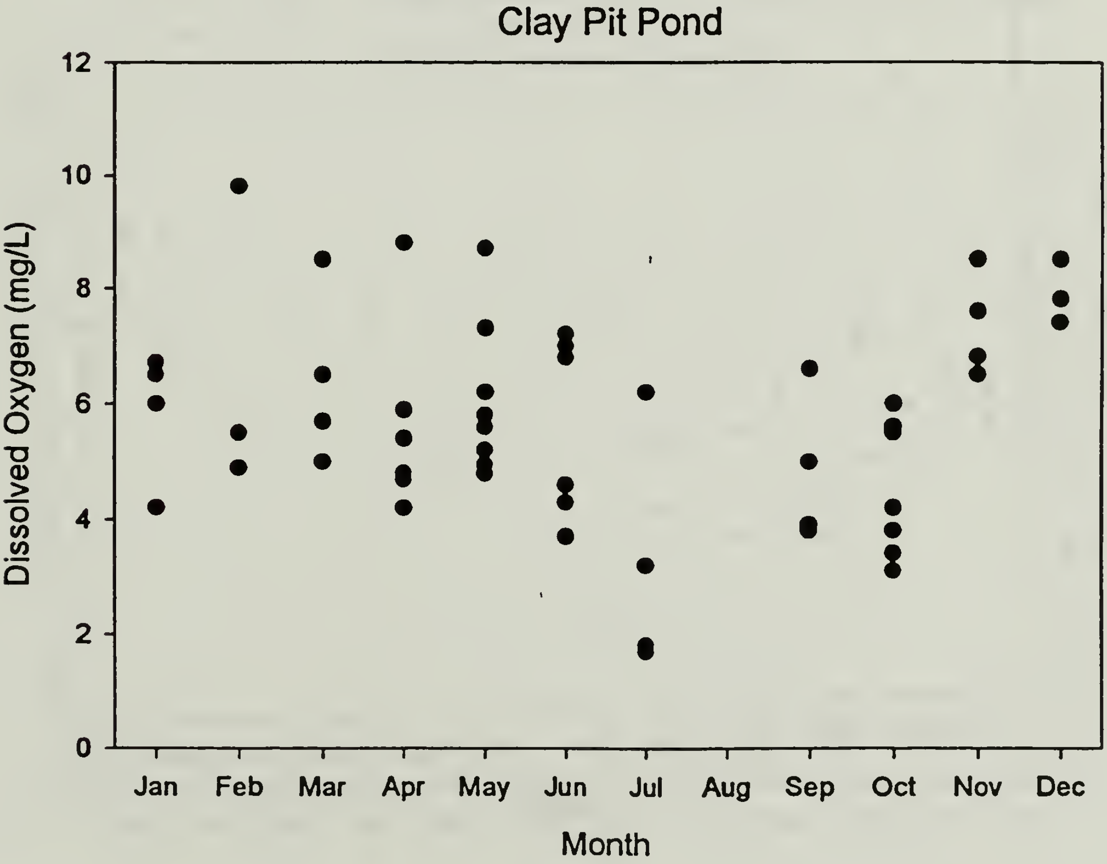


Figure 35. Monthly concentrations of dissolved oxygen of Iron Spring and Clay Pit Pond, FOCL.

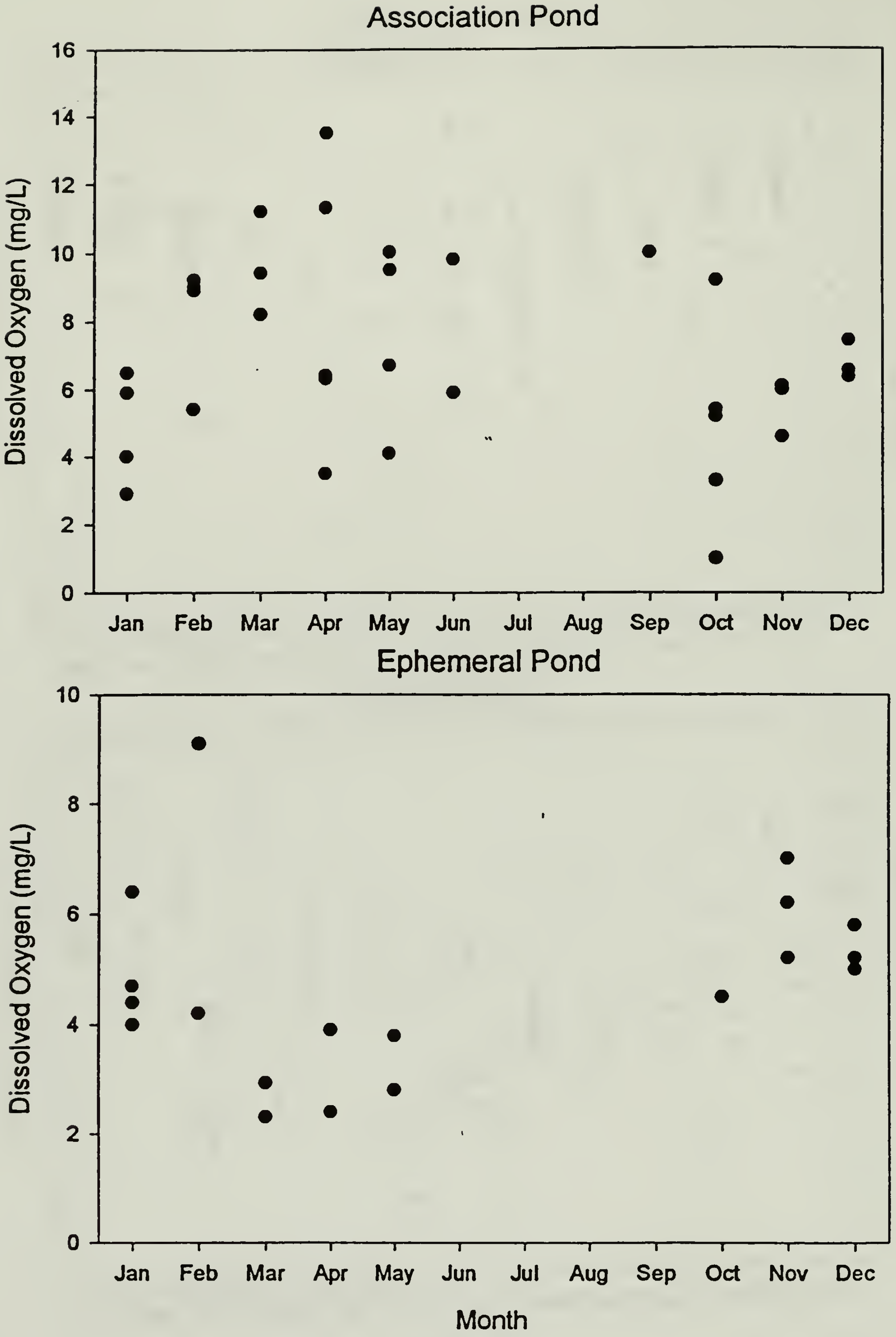


Figure 36. Monthly concentrations of dissolved oxygen of Association Pond and Ephemeral Pond, FOCL.

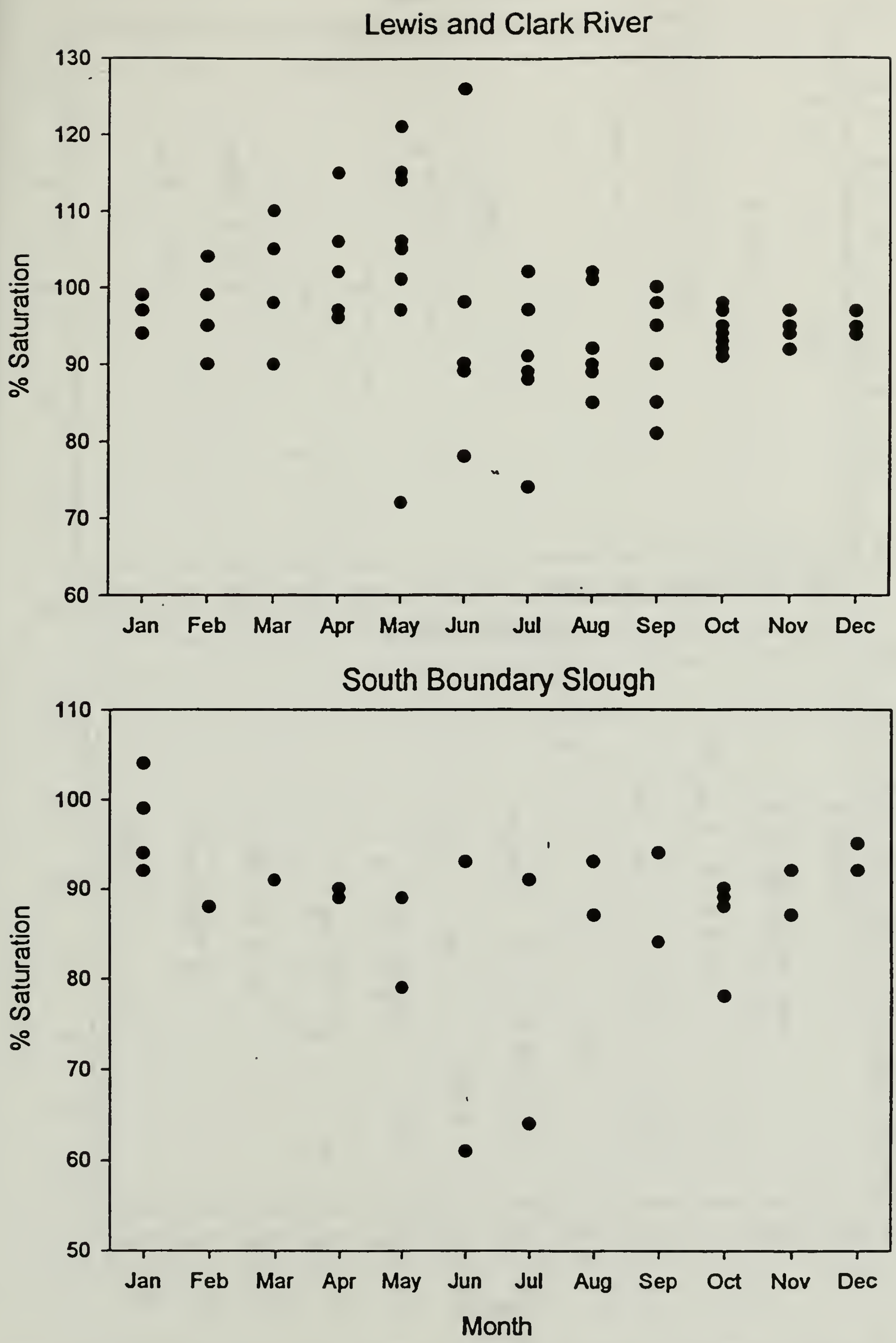


Figure 37. Monthly percent saturation of dissolved oxygen of the Lewis and Clark River and South Boundary Slough, FOCL.

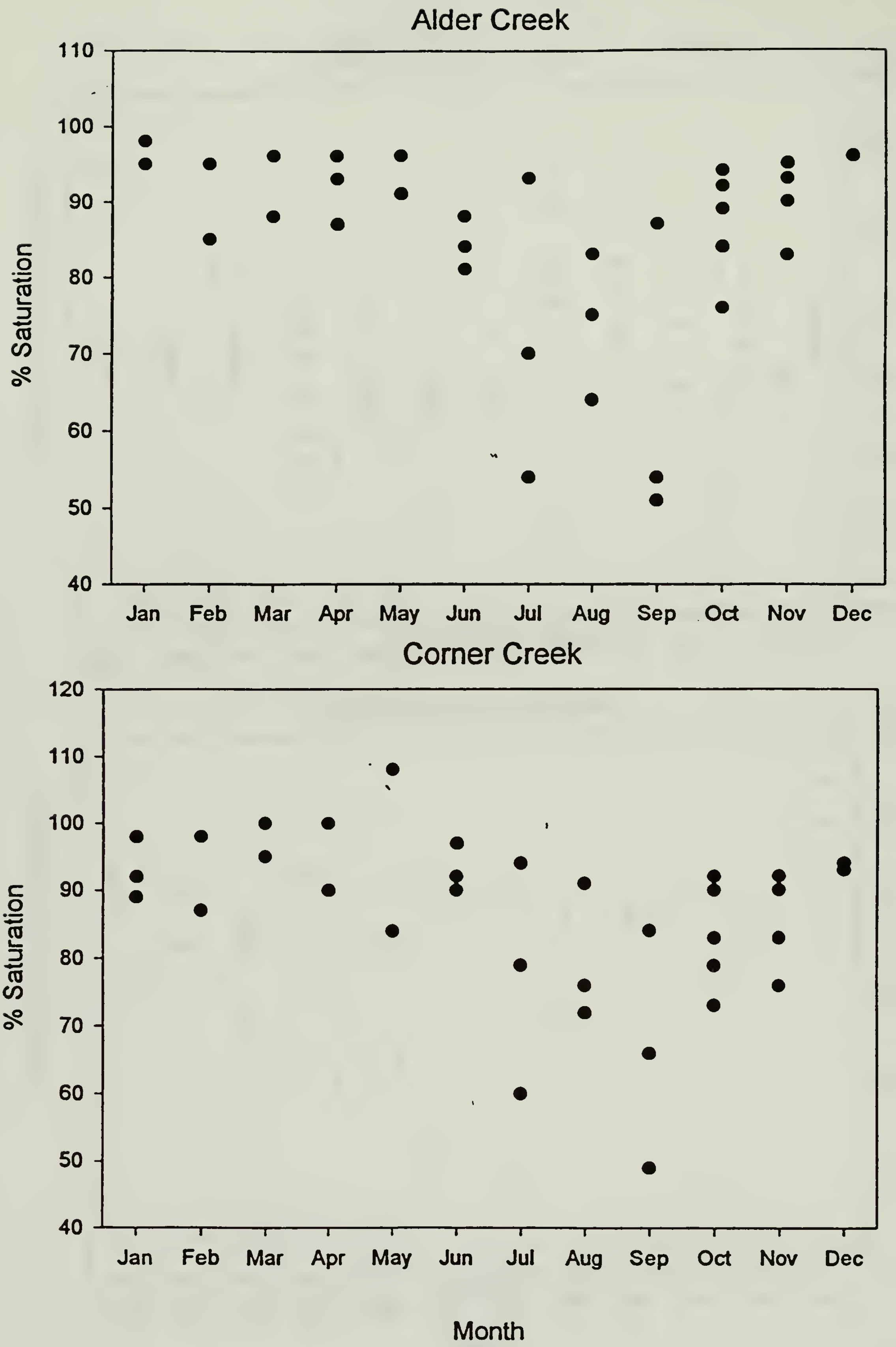


Figure 38. Monthly percentage saturation of dissolved oxygen of Alder Creek and Corner Creek, FOCL.

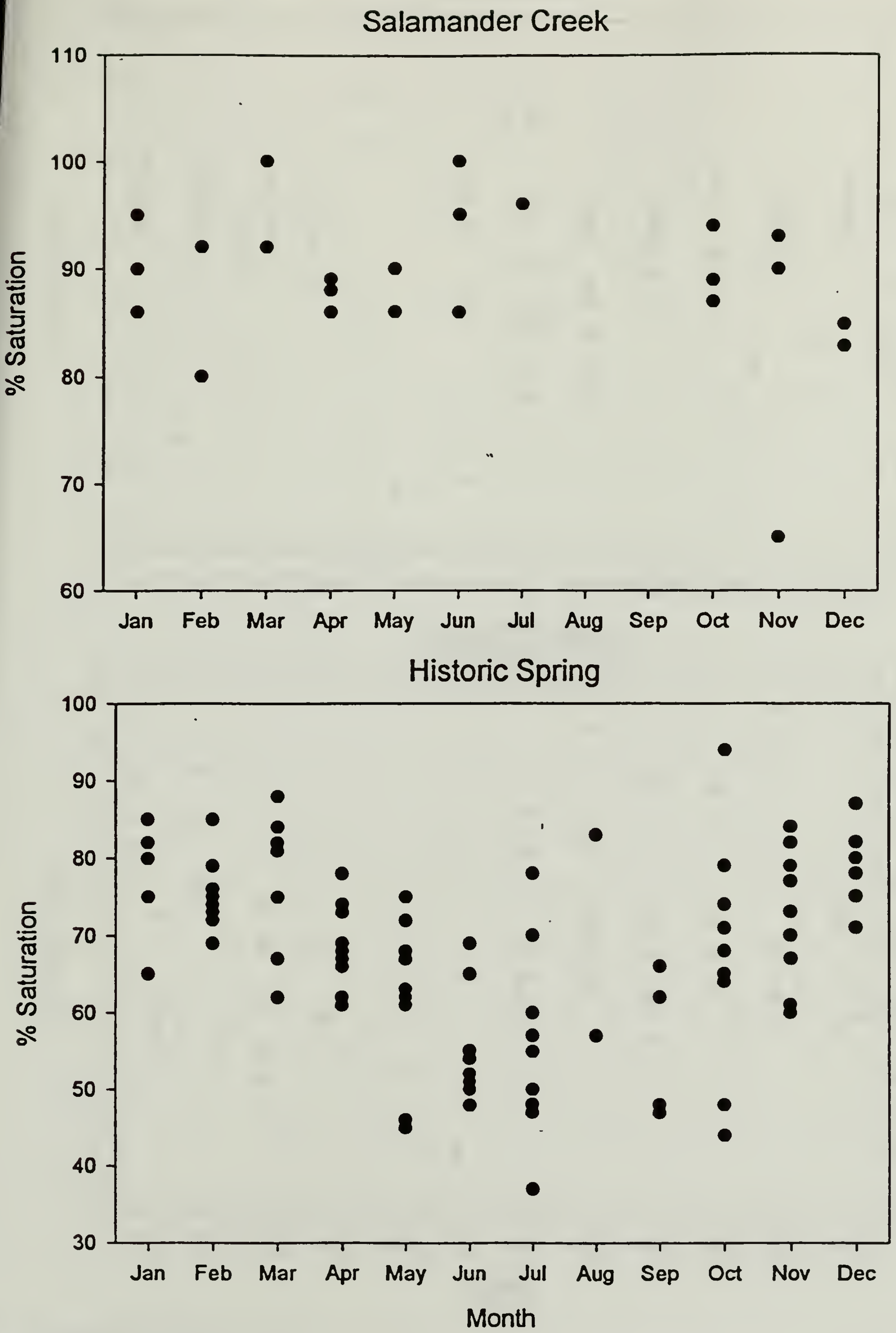


Figure 39. Monthly percent saturation of dissolved oxygen of Salamander Creek and Historic Spring, FOCL.

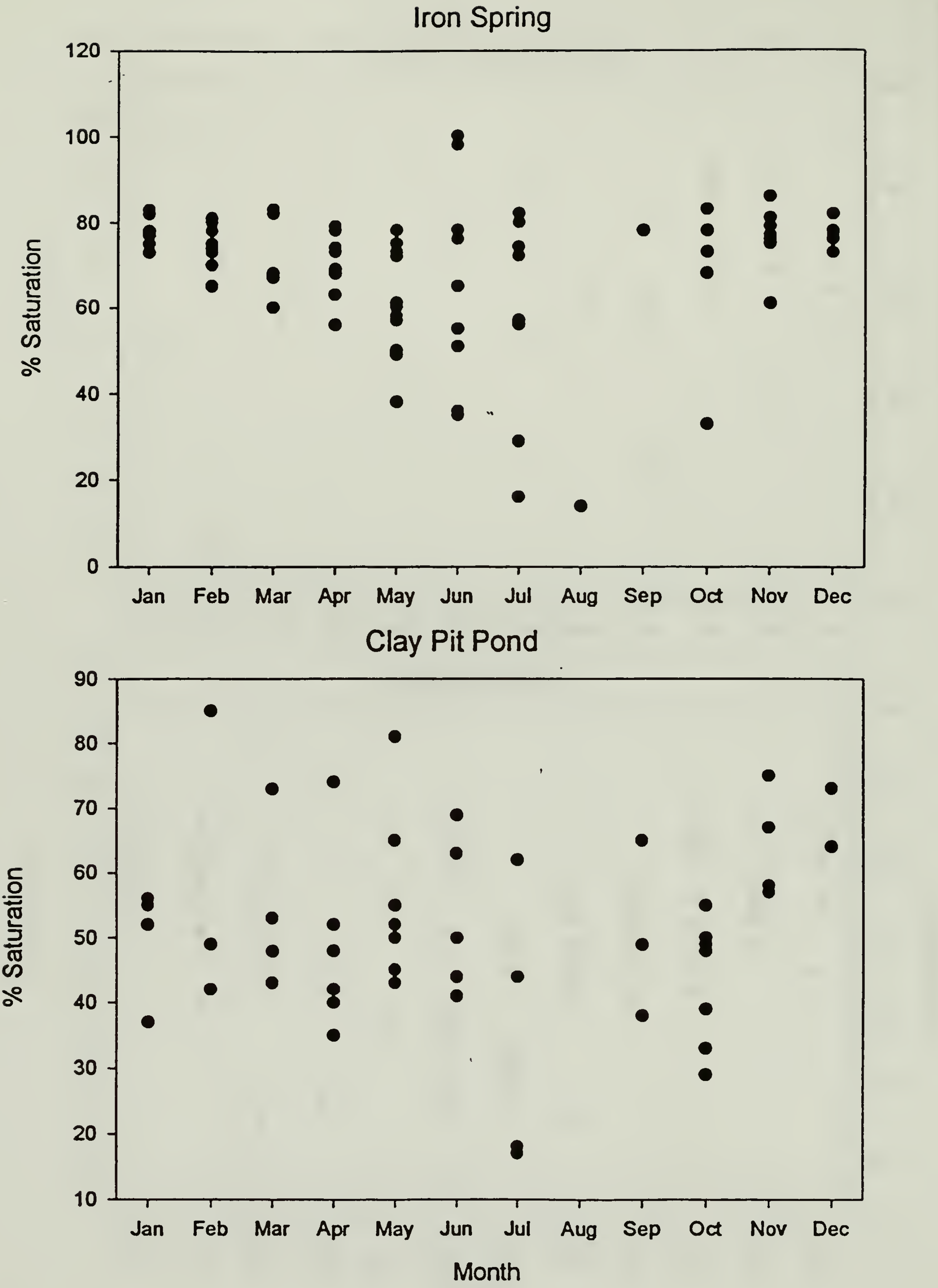


Figure 40. Monthly percent saturation of dissolved oxygen of Iron Spring and Clay Pit Pond, FOCL.

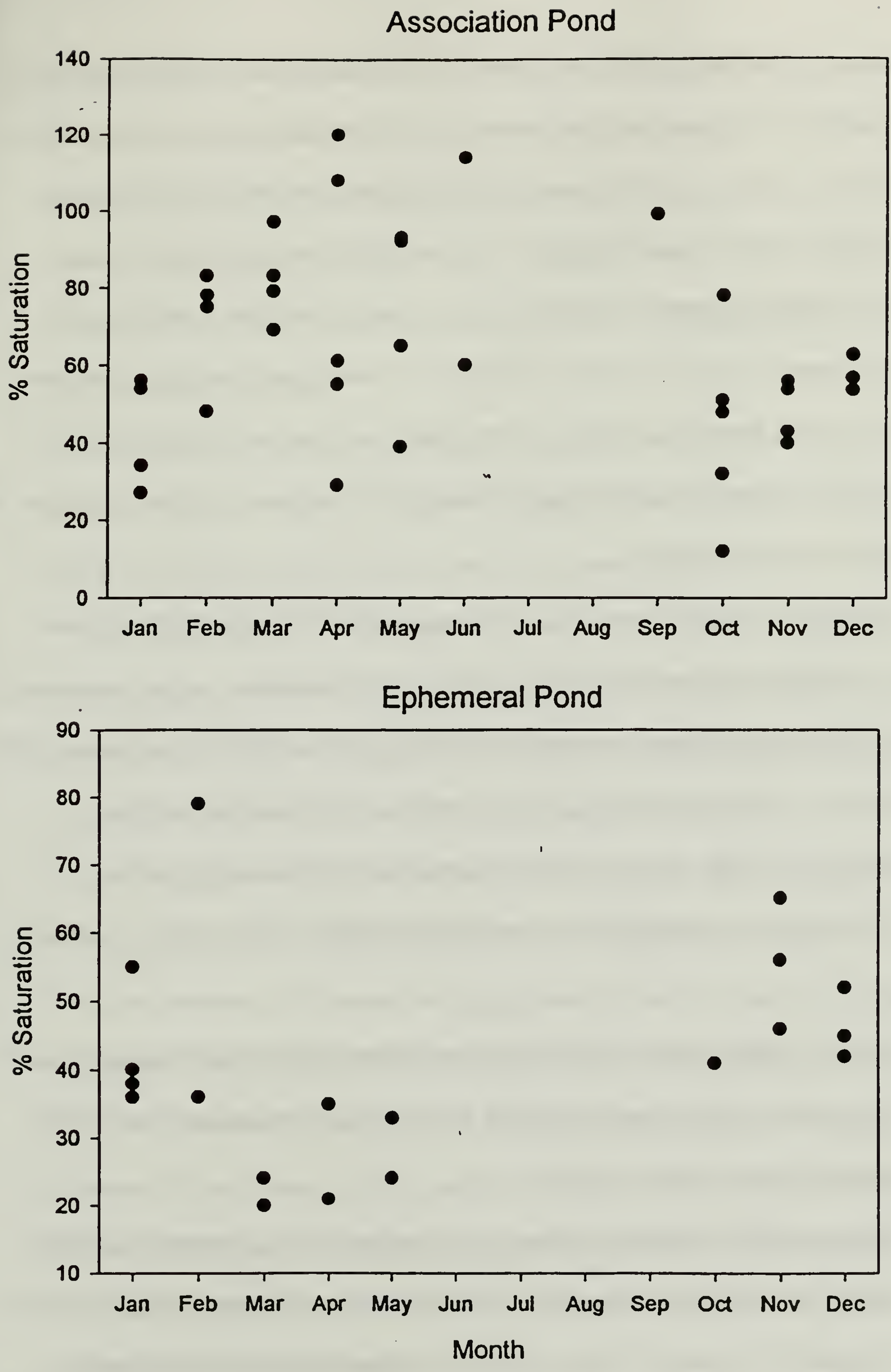


Figure 41. Monthly percent saturation of dissolved oxygen of Association Pond and Ephemeral Pond, FOCL.

temperature; (2) ALCR and COCR the highest pH, CLPO the lowest; (3) ASPO and IRSP the highest alkalinity, CLPO and SACR the lowest; (4) ASPO the highest conductivity, HISP and SACR the lowest; (5) ALCR, COCR, and SACR the highest dissolved oxygen, CLPO the lowest; and (6) ASPO the highest turbidity, CLPO and SACR the lowest. In many cases, however, considerable variation was observed in the monthly data for each variable. The observed decreases in the concentrations of dissolved oxygen that occurred in summer were related to increased water temperatures. Low pH values were observed in CLPO and EPPO, which probably resulted from organic acids in leachate from the forest floor that drained into the ponds and heterotrophic activity.

ASPO had the highest average concentrations of UTKN, FTKN, UTP, FTP, PO4-P, NH3-N, and SO4-S. HISP typically had low or the lowest concentrations of these water quality variables. EPPO had the highest concentration of NO3-N, whereas ASPO had the lowest. SBSL had the highest concentrations of Na, K, Ca, Mg, and Cl. All sites had relatively high concentrations of Cl. LECL was not sampled for any of these water quality variables.

The following recommendations are provided for additional water quality monitoring at FOCL:

(1) Initiate a long-term water quality monitoring program. The information gathered can be used to assess changes caused by natural variations of the environment and variation caused by human-related activities.

(2) The water quality data base (discharge or volume [see below], temperature, turbidity, salinity, pH, alkalinity, conductivity, and dissolved oxygen) for each study site needs to be expanded to document "normal average conditions" and the expected range of variability of each variable. Three samples should be taken each month and the results

averaged. These average values should be added to the existing data base and new averages calculated for each month by site. This effort should continue until the variance (expressed as 1 standard deviation) around the average of each variable at each site is reduced. Once the data base is large enough to document normal average conditions, sampling can be reduced to selected months each year or monthly samples could be taken every second or third year.

Water samples for nutrient and ion analyses should continue to be collected in April, June and October. Owing to the costs of such analyses, these should taken once each month and the results added to the data base as discussed above.

Since LECL and SBSL sampling sites are in the tidally influenced region of the River, sampling at these sites should be done at the same tidal stage. Futhermore, on each sampling date, the stage and height of the tide and flow of the river should be recorded. These data will be needed to interpret the water quality of these sites.

(3) Based on the present study, the water quality monitoring study should continue to include the same study sites. EPPO could be deleted because it has a short “wet phase”.

(4) Flow measurements of the creeks and springs should be taken the same day as water samples are collected during “normal” seasonal flows. Sampling during flood events will undoubtedly increase the variation of the water quality data base. Evaluating the influences of flood events on water quality will require a separate study that includes repeated sampling before, during, and after floods. Such a study would be useful to document any impacts on water quality that result from land use practices in the headwaters of ALCR and COCR.

(5) Water samples should continue to be collected and analyzed using consistent techniques and descriptions of techniques should be cross referenced to the numerical data. The location of each sampling site should be documented for future investigations.

(6) For the ephemeral study sites, annual dates of drying and dates of recharge should continue to be documented.

(7) Pond volumes should be determined on each sampling date. The techniques required to obtain this information are described by Girdner and Larson (1995).

(8) The Tetra Tech (1996) report indicated that the percent saturation of dissolved oxygen and pH in the LECL were below Oregon State water quality standards. Our results indicated that the percent saturation of dissolved oxygen met State standards, whereas our pH values were often below State standards. Tetra Tech also presented results that indicated that the amount of sediment contamination was similar to that at other depositional areas of the Columbia River, with the exception of high concentrations of dioxins/furans. These latter results suggest a source of contamination upstream from FOCL. FOCL is encouraged to continue working with other agencies in the Lower Columbia River Estuary System on this issue.

(9) FOCL is encouraged to distribute the water quality data base to local, state, and federal agencies. Furthermore, FOCL is encouraged to seek the advice and assistance from these agencies to interpret this water quality database and to assess the importance of the data to the management of the Lower Columbia River Estuary System.

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Appendix

(Tables 19-29)

Table 19. Average discharges (CFS) by month for the three streams and two springs, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	2	1	1	2	2	2	3	2	2	3	2	1
	Average	0.21	0.06	1.28	0.07	0.12	0.08	0.03	0.02	0.09	0.27	0.78	4.45
	Min-Max	0.16-0.26	-	-	0.05-0.08	0.10-0.13	0.02-0.14	0.02-0.03	0.02-0.02	0.04-0.13	0.16-0.36	0.46-1.09	-
	SD	0.07	-	-	0.02	0.02	0.09	0.01	0.0	0.07	0.10	0.44	-
	COV	33.3	-	-	28.6	16.7	112.5	33.3	0.0	77.8	37.0	56.4	-
COCR	n	2	2	1	2	2	2	3	2	2	3	2	1
	Average	2.04	0.82	2.83	0.43	0.55	0.37	0.08	0.11	0.20	0.37	3.91	17.25
	Min-Max	1.41-2.67	0.68-0.95	-	0.41-0.46	0.39-0.70	0.16-0.59	0.01-0.16	0.01-0.21	0.01-o.39	0.13-0.50	2.72-5.01	-
	SD	0.90	0.19	-	0.04	0.22	0.30	0.08	0.14	0.26	0.21	1.68	-
	COV	44.1	23.2	-	9.3	40.0	81.1	100.0	127.3	130.0	56.8	43.0	-
SACR	n	2	2	1	2	2	2	1	8	1	2	2	1
	Average	0.18	0.05	0.48	0.02	0.02	0.01	<0.01	-	<0.01	0.02	0.45	1.15
	Min-Max	0.16-0.20	0.02-0.08	-	0.01-0.02	0.01-0.02	0.01-0.01	-	-	-	0.01-0.02	0.27-0.63	-
	SD	0.03	0.04	-	0.01	0.01	0.0	-	-	-	0.01	0.26	-
	COV	16.7	80.0	-	50.0	50.0	0.0	-	-	-	50.0		57.8
HISP	n	2	2	1	2	2	2	2	1	1	2	2	2
	Average	0.11	0.13	0.29	0.03	0.02	0.01	<0.01	0.03	0.01	0.03	0.37	0.38
	Min-Max	0.08-0.15	0.04-0.22	-	0.01-0.04	0.01-0.02	0.01-0.02	-	-	-	0.01-0.05	0.30-0.45	0.18-0.58
	SD	0.05	0.13	-	0.02	0.01	0.01	-	-	-	0.03	0.11	0.28
	COV	45.5	100.0	-	66.7	50.0	50.0	-	-	-	100.0	29.7	75.0
IRSP	n	2	2	1	2	2	2	2	0	1	1	1	2

	Average	**0.03**	**0.03**	**0.09**	**<0.01**	**0.02**	**0.02**	**<0.01**	**-**	**<0.01**	**0.01**	**0.06**	**0.32**
	Min-Max	0.03-0.04	0.02-0.03	-	-	0.01-0.03	<0.01-0.04	-	-	-	-	-	0.20-0.44
	SD	0.01	0.01	-	-	0.02	0.03						0.17
	COV	33.3	33.3	-	-	100.0	150.0	-	-	-	-	-	66.70

Table 20. Average turbidity (NTU) by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	3	3	3	3	2	3	3	3	3	3	3	2
	Average	**2.3**	**2.1**	**2.2**	**10.4**	**3.3**	**4.4**	**5.4**	**13.9**	**7.7**	**7.8**	**3.9**	**5.1**
	Min-Max	1.6-2.8	1.9-2.4	1.8-2.8	9.8-11.0	3.0-3.5	3.4-5.5	4.4-6.6	5.8-26.2	5.4-8.8	3.5-14.4	1.5-6.1	3.9-6.3
	SD	0.6	0.3	0.5	0.6	0.4	1.0	1.1	10.9	1.8	5.8	2.3	1.7
	COV	26.1	14.3	22.7	5.8	12.1	22.7	20.4	78.4	23.4	74.4	59.0	33.3
COCR	n	3	3	3	3	2	3	3	3	3	3	3	3
	Average	**3.9**	**2.2**	**2.9**	**4.1**	**4.7**	**7.3**	**10.5**	**14.4**	**11.9**	**22.4**	**2.4**	**3.0**
	Min-Max	1.8-5.2	2.1-2.4	1.8-4.0	2.9-5.8	3.5-6.0	7.0-7.8	7.2-12.3	13.5-15.2	9.9-15.5	3.5-59.5	1.8-2.9	1.6-4.6
	SD	1.8	0.2	1.1	1.5	1.7	0.5	2.8	0.9	3.1	32.1	0.6	1.5
	COV	46.2	9.1	37.9	36.6	36.2	6.1	26.7	6.3	26.1	143.3	25.0	50.0
SACR	n	3	3	3	3	2	3	1	0	0	3	3	3
	Average	**2.7**	**1.7**	**1.8**	**2.7**	**2.6**	**2.5**	**1.2**	-	-	**3.4**	**1.8**	**1.5**
	Min-Max	1.3-3.8	1.4-1.9	1.2-2.1	1.7-3.7	2.5-2.8	1.9-3.3	-	-	-	2.0-5.4	1.5-1.9	1.3-1.6
	SD	1.3	0.3	0.5	1.0	0.2	0.7	-	-	-	1.8	0.3	0.2
	COV	48.2	17.7	27.8	37.0	7.7	28.0	-	-	-	52.9	16.7	13.3
LECL	n	3	3	3	3	3	3	3	3	3	3	3	3
	Average	**17.1**	**63.5**	**50.6**	**36.6**	**12.0**	**12.1**	**20.6**	**14.6**	**16.1**	**16.9**	**71.8**	**40.2**
	Min-Max	12.3-20.0	32.4-123.6	12.2-104.4	9.3-76.9	10.7-14.1	8.4-14.3	12.7-30.8	8.9-23.0	10.3-27.6	10.5-29.3	8.0-189.4	13.7-58.7
	SD	4.2	52.1	48.0	35.6	1.8	3.2	9.2	7.4	10.0	10.8	102.0	23.6
	COV	24.6	82.1	94.9	97.3	15.0	26.5	44.7	50.7	62.1	63.9	142.1	58.7
SBSL	n	3	2	2	2	2	2	2	2	2	2	2	2
	Average	**8.8**	**15.0**	**6.7**	**8.7**	**5.7**	**14.8**	**20.8**	**16.1**	**16.0**	**14.1**	**9.8**	**26.1**
	Min-Max	7.1-10.3	6.1-23.9	6,5-6.9	3.9-13.7	5.4-5.9	7.7-21.8	12.3-20.3	12.4-19.8	9.8-22.2	9.9-18.4	4.9-14.7	20.7-31.5
	SD	1.7	12.6	0.3	7.0	0.4	10.0	12.0	5.2	8.8	6.0	7.0	7.6
	COV	19.3	84.0	4.5	80.5	7.0	67.6	57.7	32.3	55.0	42.6	71.4	29.1

HISP	n	3	3	3	3	3	3	3	2	2	3	4	3
	Average	2.2	1.8	2.3	2.9	2.7	2.4	1.3	16.0	2.8	2.7	6.9	2.3
	Min-Max	1.2-3.8	1.0-2.2	1.4-3.9	1.7-4.6	2.3-3.0	1.4-3.9	1.1-1.6	1.7-30.3	2.5-3.1	2.2-3.0	1.3-18.7	1.7-3.3
	SD	1.4	0.6	1.4	1.5	0.4	1.3	0.3	20.2	0.4	0.4	8.0	0.9
	COV	63.6	33.3	60.9	51.7	14.8	54.2	23.1	126.3	14.3	14.8	115.9	39.1
IRSP	n	3	3	3	3	3	3	2	1	1	3	3	2
	Average	1.6	0.5	0.8	0.9	2.8	9.8	3.4	70.0	2.1	1.3	2.9	2.0
	Min-Max	0.8-2.2	0.4-0.6	0.8-0.9	0.9-1.0	1.0-6.4	2.6-13.6	2.7-4.2	-	-	0.8-1.7	1.3-4.4	2.0-2.0
	SD	0.7	0.1	0.1	0.1	3.1	6.3	1.1	-	-	0.5	1.6	0.0
	COV	43.8	20.0	7.9	11.1	110.7	64.3	32.4	-	-	38.5	55.2	0.0
CLPO	n	3	3	3	3	3	3	2	0	2	3	2	3
	Average	1.5	1.2	1.0	0.8	1.3	1.3	3.5	-	3.6	1.6	1.0	1.5
	Min-Max	1.0-2.5	0.8-1.6	0.7-1.5	0.6-1.0	1.0-1.7	1.1-1.6	2.3-4.7	-	3.4-3.8	0.6-2.3	0.8-1.3	0.8-2.1
	SD	0.8	0.4	0.4	0.2	0.4	0.3	1.7	-	0.3	1.6	0.4	0.7
	COV	53.3	33.3	40.0	25.0	30.8	23.1	48.6	-	8.3	100.0	40.0	46.7
ASPO	n	3	3	3	3	3	1	0	0	1	3	2	2
	Average	4.1	4.8	6.4	33.2	273.3	32.9	-	-	8.7	8.4	6.4	4.8
	Min-Max	2.7-5.6	2.8-6.5	4.6-7.7	8.7-82.0	96.1-419.9	-	-	-	-	5.3-14.7	4.8-7.9	4.1-5.5
	SD	1.5	1.9	1.6	42.3	164.0	-	-	-	-	5.4	2.2	1.0
	COV	36.6	40.0	25.0	127.4	60.0	-	-	-	-	64.3	34.4	20.8
EPPO	n	3	2	2	2	2	0	0	0	0	1	2	2
	Average	0.9	1.1	0.7	1.1	1.4	-	-	-	-	0.8	1.0	2.0
	Min-Max	0.3-1.5	0.6-1.7	0.7-0.8	0.6-1.7	1.2-1.7	-	-	-	-	-	0.7-1.4	1.1-2.9
	SD	0.6	0.8	0.1	0.8	0.4	-	-	-	-	-	0.5	1.3
	COV	66.7	72.7	14.3	72.7	28.6	-	-	-	-	-	50.0	65

Table 21. Average water temperatures (°C) by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV= coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	3	3	3	3	2	3	3	3	3	3	3	2
	Average	8.0	8.0	8.0	10.0	10.5	12.3	13.3	13.3	14.0	12.3	10.7	10.0
	Min-Max	6.5-9.0	7.0-9.0	7.0-9.0	-	10.0-11.0	12.0-13.0	13.0-14.0	13.0-14.0	13.0-15.0	12.0-13.0	9.0-12.0	-
	SD	1.3	1.0	1.0	-	0.7	0.6	0.6	0.6	1.0	0.6	1.5	-
	COV	16.3	12.5	12.5	-	6.7	4.9	4.5	4.5	7.1	4.9	14.0	-
COCR	n	3	3	3	3	3	3	3	3	3	3	3	3
	Average	7.0	7.0	7.7	9.7	10.7	12.3	14.7	14.7	15.3	12.0	10.2	8.0
	Min-Max	5.0-8.0	6.0-8.0	7.0-8.0	9.0-10.0	10.0-12.0	11.0-14.0	14.0-16.0	13.0-16.0	15.0-16.0	11.0-13.0	9.0-11.0	6.0-9.0
	SD	1.7	1.0	0.6	0.6	1.2	1.5	1.2	1.5	0.6	1.0	1.1	1.7
	COV	24.3	14.3	7.8	6.2	11.2	12.2	8.2	10.2	3.9	8.3	10.8	21.3
SACR	n	3	3	3	3	3	3	1	0	0	3	3	3
	Average	8.2	7.7	8.7	9.7	10.1	11.7	13.0	-	-	12.3	11.0	8.7
	Min-Max	7.5-9.0	7.0-8.0	8.0-9.0	9.0-10.0	9.4-11.0	10.0-13.0	-	-	-	11.0-14.0	10.0-12.0	7.0-10.0
	SD	0.8	0.6	0.6	0.6	0.8	1.5	-	-	-	1.5	1.0	1.5
	COV	9.8	7.8	6.9	6.2	7.9	12.8	-	-	-	12.2	9.1	17.2
LECL	n	3	3	3	3	4	4	5	3	3	3	3	3
	Average	8.0	9.8	9.0	12.3	16.5	19.8	21.0	21.5	18.8	14.2	9.8	8.3
	Min-Max	6.9-8.5	8.5-12.0	8.5-9.0	12.0-12.5	14.7-17.7	19.0-20.0	17.0-23.9	20.0-23.5	18.3-19.5	14.0-14.7	8.0-11.5	7.0-10.0
	SD	0.9	1.9	0.5	0.3	1.5	0.5	2.6	1.8	0.6	0.3	1.8	1.6
	COV	11.3	19.4	5.6	2.4	9.1	2.5	12.4	8.4	3.2	2.1	1.8	19.3
SBSL	n	3	2	2	2	2	2	2	2	2	2	2	2
	Average	8.6	7.5	8.5	11.5	14.5	17.5	22.0	20.5	19.5	16.0	10.0	9.3
	Min-Max	6.8-11.0	6.0-9.0	8.0-9.0	10.0-13.0	11.0-18.0	16.0-19.0	21.0-23.0	20.0-21.0	18.0-21.0	15.5-16.5	10.0-10.0	8.5-10.0

	SD	2.2	2.1	0.7	2.2	5.0	2.1	1.4	0.7	2.1	0.7	0	1.1
	COV	25.6	28.0	8.2	19.1	34.5	12.0	6.4	33.4	107.7	4.4	0.0	11.8
HISP	n	3	3	3	3	3	3	5	2	2	3	4	3
	Average	**9.1**	**9.3**	**9.4**	**10.0**	**10.7**	**11.9**	**12.0**	**14.5**	**13.8**	**12.7**	**10.7**	**9.6**
	Min-Max	8.8-9.6	9.3-9.5	9.3-9.8	9.6-10.3	10.5-11.0	11.5-12.5	10.0-12.7	14.0-15.0	13.5-14.0	12.3-13.2	9.0-12.0	9.0-10.7
	SD	0.4	0.1	0.3	0.3	0.3	0.5	1.1	0.7	0.3	0.5	1.3	0.9
	COV	4.4	1.1	3.2	3.0	2.8	4.2	9.2	4.8	2.2	3.9	12.2	9.4
IRSP	n	3	3	3	3	3	3	2	1	1	3	3	2
	Average	**9.1**	**9.1**	**9.0**	**9.7**	**10.3**	**11.5**	**13.1**	**15.0**	**13.0**	**12.0**	**11.3**	**9.8**
	Min-Max	8.5-9.5	8.8-9.8	8.3-9.4	9.3-10.0	10.0-10.6	11.0-12.0	12.3-13.8	-	-	11.5-12.3	10.5-12.0	9.0-10.7
	SD	0.5	0.6	0.6	0.4	0.3	0.5	1.0	-	-	0.5	0.8	1.2
	COV	5.5	6.6	6.7	4.1	2.9	4.4	7.6	-	-	4.2	7.1	12.3
CLPO	n	3	3	3	3	4	5	3	0	2	3	2	3
	Average	**8.2**	**8.8**	**7.9**	**8.7**	**10.4**	**14.3**	**13.9**	-	**14.7**	**11.4**	**9.5**	**7.2**
	Min-Max	7.0-9.0	8.0-9.5	7.3-8.5	8.5-9.0	9.7-11.3	11.4-22.0	11.6-15.0	-	14.0-15.3	11.0-11.7	9.0-10.0	5.0-8.5
	SD	1.0	0.8	0.6	0.3	0.7	4.4	2.0	-	0.9	0.4	0.7	1.9
	COV	12.2	9.1	7.6	3.5	6.7	30.8	14.4	-	6.1	3.5	7.4	26.5
ASPO	n	3	3	3	3	4	1	1	0	1	3	3	2
	Average	**7.8**	**9.8**	**8.8**	**11.3**	**12.9**	**19.5**	**15.0**	-	**15.0**	**11.0**	**9.0**	**8.8**
	Min-Max	6.0-9.0	9.0-11.0	8.5-9.0	10.5-13.0	10.0-15.0	-	-	-	-	10.0-12.0	5.5=11.0	7.5-10.0
	SD	1.6	1.0	0.3	1.4	2.1	-	-	-	-	1.0	3.0	1.8
	COV	20.5	10.2	3.4	12.4	16.3	-	-	-	-	9.1	33.3	20.5
EPPO	n	3	2	2	2	2	0	0	0	0	1	2	2
	Average	**9.0**	**9.5**	**8.5**	**9.5**	**9.5**	-	-	-	-	**11.0**	**10.8**	**9.8**
	Min-Max	9.0-9.0	9.0-10.0	8.0-9.0	9.0-10.0	9.0-10.0	-	-	-	-	-	10.0-11.5	8.5-11.0
	SD	0.0	0.7	0.7	0.7	0.7	-	-	-	-	-	1.1	1.8
	COV	0.0	7.4	8.2	7.4	7.4	-	-	-	-	-	10.2	18.4

Table 22. Average pH by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	3	3	2	3	2	3	3	3	3	3	3	2
	Average	6.0	6.1	6.3	6.1	6.2	6.3	6.2	5.2	6.5	6.3	6.2	6.2
	Min-Max	5.7-6.5	5.8-6.6	6.2-6.3	6.0-6.4	6.1-6.3	6.2-6.4	6.2-6.3	4.7-7.9	6.3-7.6	6.1-6.7	6.0-6.6	5.9-6.9
COCR	n	3	3	2	3	2	3	3	3	3	3	3	3
	Average	6.0	6.3	6.3	6.2	6.2	6.7	6.7	5.5	5.6	6.3	6.4	6.1
	Min-Max	5.7-6.3	6.1-6.6	6.1-6.4	5.9-6.8	6.1-6.3	6.6-6.9	6.6-6.9	5.0-8.6	5.1-7.0	6.0-6.8	6.3-6.4	5.8-7.6
SACR	n	3	3	2	3	2	3	1	0	0	3	3	3
	Average	5.1	5.8	5.9	5.7	6.0	6.7	6.5	-	-	5.5	5.7	5.6
	Min-Max	4.7-6.1	5.7-5.9	5.8-6.0	5.5-5.8	5.9-6.3	6.5-7.2	-	-	-	5.3-5.6	5.6-5.8	5.3-6.6
LECL	n	3	3	3	3	3	3	3	3	3	3	2	3
	Average	6.1	6.4	6.3	6.6	6.7	6.9	7.0	7.0	7.0	6.6	6.3	6.0
	Min-Max	5.9-6.4	6.3-6.7	6.2-6.6	6.4-7.2	6.6-6.8	6.7-7.1	7.0-7.1	6.8-7.4	6.8-7.4	6.4-6.8	6.3-6.3	5.7-6.3
SBSL	n	3	2	2	2	2	2	2	2	2	2	2	2.0
	Average	6.1	6.8	6.4	6.2	6.3	6.8	6.7	5.6	7.4	6.8	6.4	6.6
	Min-Max	5.7-6.6	6.7-6.9	6.3-6.5	6.0-6.9	6.2-6.5	6.6-6.9	6.7-6.8	5.3-8.4	7.1-8.6	6.8-6.8	6.2-6.6	6.2-7.2
HISP	n	3	3	3	3	3	3	3	2	2	3	2	

	Average	4.8	5.7	5.7	5.6	5.6	5.9	6.0	5.9	5.5	5.5	5.6	5.3
	Min-Max	4.4-5.9	5.5-5.8	5.6-5.9	5.3-5.8	5.5-5.9	5.8-6.0	5.8-6.1	5.8-6.1	5.5-5.6	5.4-5.9	5.3-6.2	4.9-6.1
IRSP	n	3	3	3	3	3	3	2	1	1	3	3	2
	Average	5.2	5.6	5.6	5.6	5.6	6.1	6.3	6.6	5.7	5.6	5.5	5.6
	Min-Max	4.8-5.8	5.4-5.8	5.6-5.7	5.4-5.8	5.4-6.0	5.8-6.4	6.1-6.6	-	-	5.4-6.1	5.3-5.9	5.5-5.8
CLPO	n	3	3	3	3	3	3	2	0	2	3	2	3
	Average	4.5	5.0	5.2	5.2	5.1	5.8	5.6	-	5.3	5.4	5.6	5.2
	Min-Max	4.3-5.4	4.6-5.5	5.1-5.4	5.0-5.4	4.9-5.5	5.6-6.4	5.5-5.8	-	5.2-5.5	5.3-5.6	5.6-5.7	4.9-5.8
ASPO	n	3	3	3	3	3	1	0	0	1	3	2	2
	Average	5.2	6.0	6.0	5.8	5.7	5.8	-	-	5.5	5.6	6.0	6.1
	Min-Max	4.7-6.2	5.8-6.1	5.9-6.1	5.6-6.0	5.5-5.9	-	-	-	-	5.5-5.6	5.7-6.4	5.9-6.5
EPPO	n	3	2	2	2	2	0	0	0	0	1	2	2
	Average	4.4	4.6	4.8	5.1	5.1	-	-	-	-	4.7	5.0	5.2
	Min-Max	4.0-5.2	4.4-5.2	4.6-5.0	4.9-5.3	4.9-5.2	-	-	-	-	-	4.8-5.2	5.2-5.2

Table 23. Average alkalinity (mg/L) by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	2	2	2	2	1	3	3	3	3	3	3	2
	Average	12.5	12.0	13.0	9.0	10.0	14.7	19.3	24.7	30.7	17.0	13.3	10.0
	Min-Max	12.0-12.0	8.0-16.0	10.0-16.0	6.0-12.0	-	12.0-16.0	18.0-20.0	22.0-26.0	20.0-38.0	15.0-20.0	10.0-18.0	8.0-12.0
	SD	0.7	5.7	4.2	4.2	-	2.3	1.2	2.3	9.5	2.7	4.2	2.8
	COV	5.6	47.5	32.3	46.7	-	15.7	6.1	9.3	30.9	15.9	31.6	28.0
COCR	n	2	2	2	2	1	3	3	3	3	3	3	2
	Average	11.5	10.0	12.0	10.0	12.0	20.7	26.0	34.0	32.7	20.3	16.7	10.0
	Min-Max	10.0-13.0	8.0-12.0	8.0-16.0	6.0-14.0	-	20.0-22.0	24.0-30.0	30.0-38.0	26.0-40.0	12.0-28.0	12.0-24.0	10.0-10.0
	SD	2.1	2.8	5.7	5.7	-	1.2	3.5	4.0	7.0	8.0	6.4	0.0
	COV	18.3	28.0	47.5	57.0	-	5.8	13.5	11.8	21.4	39.4	38.3	0.0
SACR	n	2	2	2	2	1	3	1	0	0	3	3	2
	Average	8.0	7.0	10.0	7.0	8.0	11.3	16.0	-	-	10.0	8.7	8.0
	Min-Max	6.0-10.0	4.0-10.0	8.0-12.0	6.0-8.0	-	10.0-14.0	-	-	-	8.0-12.0	6.0-12.0	-
	SD	2.8	4.2	2.8	1.4	-	2.3	-	-	-	2.0	3.1	-
	COV	35.0	60.0	28.0	28.6	-	20.9	-	-	-	20.0	35.6	-
LECL	n	2	2	2	2	2	3	3	3	3	3	2	2
	Average	24.0	29.0	31.8	36.0	32.0	41.3	47.7	60.3	64.0	49.6	28.0	34.5
	Min-Max	22.0-26.0	17.0-41.0	30.0-33.5	31.0-41.0	28.0-36.0	32.0-53.0	44.0-52.0	52.0-68.0	52.0-74.0	45.0-52.7	21.0-35.0	29.0-40.0
	SD	2.8	17.0	2.5	7.1	5.7	10.7	4.0	8.0	11.1	4.0	9.9	7.8
	COV	11.7	58.6	7.9	19.7	17.8	25.9	8.4	13.3	17.3	8.1	32.1	22.6
SBSL	n	2	1	1	1	1	2	1	2	2	2	2	2
	Average	22.7	11.0	32.0	14.0	20.0	32.0	50.0	57.0	74.0	42.8	36.0	28.0
	Min-Max	22.0-23.3	-	-	-	-	30.0-34.0	-	54.0-60.0	74.0-74.0	37.0-48.5	28.0-44.0	26.0-30.0
	SD	0.9	-	-	-	-	2.8	-	4.2	0.0	8.1	11.3	2.8
	COV	4.0	-	-	-	-	9.8	-	7.4	0.0	18.9	31.4	10.0

HISP	n	2	2	2	2	2	3	3	2	2	3	3	2
	Average	10.5	11.0	9.8	12.3	12.5	16.4	20.7	18.0	16.0	12.7	11.0	11.6
	Min-Max	10.0-11.0	9.5-12.5	9.0-10.5	11.0-13.5	12.0-13.0	13.9-19.3	18.5-22.0	16.0-20.0	15.0-17.0	11.0-15.2	9.5-13.5	10.7-12.5
	SD	0.7	2.1	1.1	1.8	0.7	2.7	1.9	2.8	1.4	2.2	2.2	1.3
	COV	0.7	19.1	11.2	14.6	5.6	16.5	9.2	15.6	7.8	17.3	20.0	11.2
IRSP	n	2	2	2	2	2	3	2	1	1	3	3	2
	Average	10.0	11.4	12.1	15.3	15.6	29.9	51.4	64.0	24.0	18.9	11.7	9.2
	Min-Max	10.0-10.0	10.8-12.0	10.0-14.2	14.0-16.5	14.0-17.2	20.0-38.7	34.0-68.8	-	-	10.0-34.7	8.0-16.0	9.0-9.3
	SD	0	0.9	2.9	1.8	2.3	9.4	24.6	-	-	13.7	4.0	0.2
	COV	O.O	7.9	24.0	11.8	14.7	31.4	47.9	-	-	72.5	34.2	2.2
CLPO	n	2	2	2	2	2	3	2	0	2	3	2	2
	Average	8.0	8.0	7.5	8.3	9.7	11.7	16.0	-	11.0	10.2	8.0	8.5
	Min-Max	8.0-8.0	8.0-8.0	7.0-8.0	6.5-10.0	8.7-10.7	10.0-14.0	15.0-17.0	-	10.0-12.0	10.0-10.7	7.0-9.0	7.0-10.0
	SD	0	0	0.7	2.5	1.4	2.1	1.4	-	1.4	0.4	1.4	2.1
	0.0	0.0	O.O	9.3	30.1	14.4	18.0	8.8	-	12.7	3.9	17.5	24.7
ASPO	n	2	2	2	2	2	1	0	0	1	3	2	2
	Average	7.8	24.0	23.5	35.5	38.7	36.0	-	-	20.0	21.7	22.0	26.0
	Min-Max	6.0-9.0	19.0-29.0	17.0-30.0	30.0-41.0	35.3-42.0	-	-	-	-	18.0-28.0	18.0-26.0	22.0-30.0
	SD	1.6	7.1	9.2	7.8	4.7	-	-	-	-	5.5	5.7	5.7
	COV	20.5	29.6	39.1	22.0	12.2	-	-	-	-	25.4	25.9	21.9
EPPO	n	2	1	1	1	1	0	0	0	0	1	2	2
	Average	8.5	8.0	8.0	10.0	4.0	-	-	-	-	8.0	8.5	8.0
	Min-Max	8.0-9.0	-	-	-	-	-	-	-	-	-	8.0-9.0	6.0-10.0
	SD	0.7	-	-	-	-	-	-	-	-	-	0.7	2.8
	COV	8.2	-	-	-	-	-	-	-	-	-	8.2	35

Table 24. Average conductivity (uS/cm) by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	3	3	3	3	2	3	3	3	3	2	3	2
	Average	50.0	50.0	50.0	53.3	60.0	61.7	73.3	73.3	100.0	77.5	56.7	55.0
	Min-Max	50.0-50.0	50.0-50.0	50.0-50.0	50.0-60.0	60.0-60.0	60.0-65.0	70.0-80.0	70.0-80.0	70.0-140.0	70.0-85.0	50.0-60.0	50.0-60.0
	SD	0.0	0.0	0.0	5.8	0.6	2.9	5.8	5.8	36.1	10.6	5.8	7.1
	COV	0.0	0.0	0.0	10.9	1.0	4.7	7.9	7.9	0.2	13.7	10.2	12.9
COCR	n	3	3	3	3	2	3	3	3	3	3	3	3
	Average	51.7	56.7	56.7	60.0	65.0	66.7	83.3	93.3	150.0	70.0	60.0	53.3
	Min-Max	50.0-55.0	50.0-60.0	50.0-60.0	60.0-60.0	60.0-70.0	60.0-70.0	70.0-100.0	70.0-120.0	100.0-200.0	60.0-75.0	60.0-60.0	50.0-60.0
	SD	2.9	5.8	5.8	0.0	7.1	5.8	15.3	25.2	50.0	8.7	0.0	5.8
	COV	5.6	10.2	10.2	0.0	10.9	8.7	18.4	27.0	33.3	12.4	0.0	10.9
SACR	n	3	3	3	3	2	3	1	0	0	3	3	3
	Average	41.7	36.7	40.0	40.0	40.0	51.7	50.0	-	-	60.0	50.0	43.3
	Min-Max	40.0-45.0	30.0-40.0	40.0-40.0	40.0-40.0	40.0-40.0	50.0-55.0	-	-	-	50.0-70.0	50.0-50.0	40.0-50.0
	SD	2.9	5.8	0.0	0.0	0.0	2.9	-	-	-	10.0	0.0	5.8
	COV	7.0	15.8	0.0	0.0	0.0	5.6	-	-	-	16.7	0.0	13.4
LECL	n	3	3	3	3	3	4	4	3	3	3	3	3
	Average	559.2	221.7	224.2	491.7	251.1	1411.3	917.0	3015.0	3583.3	2838.3	1395.0	369.2
	Min-Max	55.0-14497.5	50-480	150.0-335.0	162.5-712.5	95.0-488.3	95.0-2900.0	220.0-1950.0	95.0-4900.0	100.0-5950.0	170.0-4700.0	110.0-2100.0	190.0-482.5
	SD	813.2	227.7	97.8	290.6	208.8	1149.6	742.5	2564.3	3080.7	2370.3	1114.6	157.0
	COV	145.4	102.7	43.6	59.1	83.2	81.5	81.0	85.1	86.0	83.5	80.0	42.5
SBSL	n	3	2	2	2	2	2	2	2	2	2	2	2
	Average	71.1	222.0	85.0	430.0	212.5	400.0	1415.0	3220.0	3040.0	2910.0	2395.0	55.0
	Min-Max	70.0-73.3	45.0-400.0	80.0-90.0	60.0-800.0	75.0-350.0	100.0-700.0	130.0-2700.0	440.0-6000.0	80.0-6000.0	70.0-5750.0	490.0-4300.0	50.0-60.0
	SD	1.9	251.0	7.1	523.3	194.5	424.3	1817.3	3931.5	4186.1	4016.4		

	COV	2.7	113.1	8.4	121.7	91.5	106.1	128.4	122.1	137.7	138.0	112.5	12.9
HISP	n	3	3	3	3	3	3	3	2	2	3	4	3
	Average	44.7	46.3	45.6	47.9	51.0	56.3	57.8	57.5	61.3	49.3	46.9	46.0
	Min-Max	44.0-45.0	43.8-50.0	42.5-47.5	45.0-52.5	48.0-55.0	55.0-58.8	50.0-63.3	55.0-60.0	60.0-62.5	48.0-50.0	42.5-50.0	45.0-47.5
	SD	0.6	3.3	2.7	4.0	3.6	2.2	6.9	3.5	1.8	1.2	3.8	1.3
	COV	1.3	7.1	5.9	8.4	7.1	3.9	11.9	6.1	2.9	2.4	8.1	2.8
IRSP	n	3	3	3	3	3	3	2	1	1	3	3	2
	Average	62.5	62.1	62.2	61.3	66.2	78.3	113.0	90.0	65.0	73.6	63.3	77.0
	Min-Max	60.0-65.0	58.8-67.5	56.7-68.8	57.5-65.0	57.5-75.0	70.0-85.0	90.0-136.0	-	-	65.0-88.3	62.5-65.0	60.0-93.3
	SD	2.5	4.7	6.1	3.8	8.8	7.6	32.5	-	-	12.8	1.4	24.0
	COV	4.0	7.6	9.8	6.2	13.3	9.7	28.8	-	-	17.4	2.2	31.2
CLPO	n	3	3	3	3	3	3	2	0	2	3	2	3
	Average	61.7	60.0	60.0	59.2	71.7	71.7	72.5	-	115.0	72.2	60.0	107.5
	Min-Max	60.0-65.0	55.0-65.0	55.0-65.0	57.5-60.0	61.7-90.0	60.0-90.0	70.0-75.0	-	70.0-160.0	70.0-76.7	60.0-60.0	60.0-200.0
	SD	2.9	5.0	5.0	1.4	15.9	16.1	3.5	-	63.6	3.9	0.0	80.1
	COV	4.7	8.3	8.3	2.4	22.4	22.6	4.8	-	55.3	5.4	0.0	74.5
ASPO	n	3	3	3	3	3	1	1	0	1	3	3	2
	Average	45.0	55.0	62.0	92.5	121.7	100.0	360.0	-	120.0	132.0	586.7	65.0
	Min-Max	40.0-50.0	45.0-65.0	45.0-75.0	65.0-125.0	100.0-155.0	-	-	-	-	90.0-200.0	75.0-1600.0	60.0-70.0
	SD	5.0	10.0	15.4	30.3	29.3	-	-	-	-	59.1	877.6	7.1
	COV	11.1	18.2	24.8	32.8	24.1	-	-	-	-	44.8	149.6	10.9
EPPO	n	3	2	2	2	2	0	0	0	0	1	2	2
	Average	53.3	62.5	60.0	55.0	55.0	-	-	-	-	60.0	62.5	65.0
	Min-Max	50.0-55.0	60.0-65.0	60.0-60.0	50.0-60.0	50.0-60.0	-	-	-	-	-	60.0-65.0	56-89
	SD	2.9	3.5	0.0	7.1	7.1	-	-	-	-	-	3.5	3.5
	COV	5.4	5.6	0.0	12.9	12.9	-	-	-	-	-	5.6	5.4

Table 25. Average salinity (%) by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
LECL	n	3	3	3	3	4	4	5	3	3	3	3	3
	Average	0.5	0.2	0.2	0.7	0.1	0.8	2.1	4.2	4.9	3.2	1.2	0.3
	Min-Max	0.0-1.4	0.0-0.5	0.0-0.5	0.5-1.0	0.0-0.5	0.0-2.0	0.0-5.0	2.5-6.5	3.3-7.0	2.3-4.3	0.0-2.0	0.0-0.5
	SD	0.8	0.3	0.3	0.3	0.3	0.9	2.1	2.1	1.9	1.1	1.0	0.3
	Cov	160.0	150.0	150.0	42.9	300.0	112.5	100.0	50.0	38.8	34.4	83.3	100.0
SBSL	n	3	2	2	2	2	2	2	2	2	2	2	2
	Average	0.1	0.0	0.0	0.3	0.0	0.5	1.5	3.5	4.5	4.8	4.0	0.0
	Min-Max	0.0-0.3	-	-	0.0-0.5	-	0.0-1.0	1.0-2.0	3.0-4.0	4.0-5.0	4.5-5.0	4.0-4.0	-
	SD	0.2	-	-	0.4	-	0.7	0.7	0.7	0.7	0.4	0	-
	cov	200.0	-	-	133.3	-	140.0	46.7	20.0	15.6	8.3	0.0	-
ASPO	n	3	3	3	3	4	1	2	0	1	3	3	2
	Average	0.0	0.0	0.0	0.0	0.0	0.0	1.5	-	0.0	0.0	0.5	0.0
	Min-Max	-	-	-	-	-	-	0.0-3.0	-	-	-	0.0-1.5	-
	SD	-	-	-	-	-	-	2.1	-	-	-	0.9	-
	COV	-	-	-	-	-	-	140.0	-	-	-	180.0	-

Table 26. Average dissolved oxygen (mg/L) by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	2	2	2	3	2	3	3	3	3	3	3	2
	Average	11.2	10.7	11.2	10.4	10.5	9.0	7.6	7.7	6.5	9.5	10.3	10.8
	Min-Max	11.1-11.3	10.3-11.0	10.8-11.6	9.8-11.0	10.3-10.6	8.7-9.3	5.5-9.8	6.7-8.6	5.3-8.8	9.1-10.2	9.6-10.8	10.8-10.8
	SD	0.1	0.5	0.6	0.6	0.2	0.3	2.2	1.0	2.0	0.7	0.6	0.0
	COV	0.9	4.7	5.4	5.8	1.9	3.3	29.0	13.0	30.8	7.4	5.8	0.0
COCR	n	2	2	2	3	2	3	3	3	3	3	3	2
	Average	11.8	11.1	11.8	11.1	10.7	9.9	7.9	8.1	6.7	9.2	9.8	10.9
	Min-Max	11.7-11.9	10.9-11.3	11.5-12.0	10.2-11.7	9.1-12.2	9.7-10.2	5.9-9.7	7.2-9.0	4.9-8.5	8.0-10.0	8.9-10.4	10.8-10.9
	SD	0.1	0.3	0.4	0.8	2.2	0.3	1.9	0.9	1.8	1.1	0.8	0.1
	COV	0.9	2.7	3.4	7.2	20.6	3.0	24.1	11.1	26.9	12.0	8.2	0.9
SACR	n	2	2	2	3	2	3	1	0	0	3	3	2
	Average	10.8	10.4	11.3	10.0	9.9	10.2	10.2	-	-	9.5	9.5	9.7
	Min-Max	10.7-10.8	9.7-11.0	10.6-11.9	9.7-10.3	9.5-10.2	9.7-10.6	-	-	-	9.2-9.8	8.7-10.2	9.4-9.9
	SD	0.1	0.9	0.9	0.3	0.5	0.5	-	-	-	0.3	0.8	0.4
	COV	0.9	8.7	8.0	3.0	5.1	4.9	-	-	-	3.2	8.4	4.1
LECL	n	2	2	2	3	3	3	3	3	3	3	2	2
	Average	11.3	11.3	11.7	11.1	10.1	8.8	8.0	8.1	8.5	9.6	10.5	11.2
	Min-Max	11.3-11.4	11.2-11.5	11.5-12.0	10.6-11.4	8.6-11.4	7.6-10.2	7.2-8.7	7.9-8.5	7.8-9.0	9.1-9.9	10.3-10.8	10.7-11.8
	SD	0.1	0.2	0.3	0.4	1.4	1.3	0.7	0.3	0.6	0.4	0.4	0.7
	COV	0.9	1.8	2.6	3.6	13.9	14.8	8.8	3.7	7.1	4.2	3.8	6.3
SBSL	n	2	1	1	2	2	2	2	2	2	2	2	2
	Average	12.0	11.0	10.8	9.8	8.6	7.3	6.8	8.1	8.2	8.5	10.1	10.7
	Min-Max	11.6-12.3	-	-	9.4-10.2	8.4-8.7	6.0-8.6	5.5-8.1	7.7-8.4	7.5-8.9	8.2-8.9	9.7-10.4	10.7-10.7
	SD	0.5	-	-	0.6	0.2	1.8	1.8	0.5	1.0	0.5	0.5	0.0
	COV	4.2	-	-	6.1	2.3	24.7	26.5	6.2	12.2	5.9	5.0	0.0

HISP	n	2	2	2	3	3	3	3	2	52	3	3	2
	Average	9.2	8.7	8.7	7.6	5.8	6.3	5.9	6.5	5.8	7.2	7.9	8.9
	Min-Max	8.8-9.5	8.6-8.8	7.7-9.6	6.9-7.9	5.8-8.0	5.6-7.2	4.5-7.1	5.9-7.1	5.7-5.9	7.0-7.4	7.6-8.5	8.5-9.3
	SD	0.5	0.1	1.4	0.6	1.1	0.8	1.3	0.8	0.1	0.2	0.5	0.6
	COV	5.4	1.2	16.1	7.9	19.0	12.7	22.0	12.3	1.7	2.8	6.3	6.7
IRSP	n	2	2	2	3	3	3	2	1	1	3	3	2
	Average	9.0	8.7	8.6	7.9	7.4	7.7	6.4	0.5	8.2	7.8	8.4	8.7
	Min-Max	8.7-9.4	8.3-9.0	7.6-9.6	7.4-8.5	5.7-8.8	4.8-9.8	5.2-7.6	-	-	6.2-7.8	8.0-8.9	8.4-9.0
	SD	0.5	0.4	1.5	0.5	1.6	2.6	1.7	-	-	1.4	0.5	0.4
	COV	5.6	4.6	17.4	6.3	21.6	33.8	26.6	-	-	18.0	5.9	4.6
CLPO	n	2	2	2	3	3	3	2	0	2	3	2	2
	Average	5.9	6.3	6.4	5.6	6.0	5.6	3.2	-	4.5	4.6	7.4	8.1
	Min-Max	5.5-6.3	4.9-7.7	5.4-7.5	4.8-7.4	5.7-6.4	5.3-5.8	2.5-4.0	-	3.9-5.1	4.3-5.1	7.2-7.5	7.6-8.5
	SD	0.6	2.0	1.5	1.5	0.3	0.3	1.0	-	0.9	0.4	0.2	0.6
	COV	10.2	31.8	23.4	26.8	5.0	5.4	31.3	-	20.0	8.7	2.7	7.4
ASPO	n	2	2	2	3	3	1	0	0	1	3	2	2
	Average	4.8	8.1	9.6	7.9	6.9	7.9	-	-	10.0	4.9	5.3	6.7
	Min-Max	4.7-5.0	7.2-9.1	9.4-9.7	6.3-8.9	4.1-10.0	-	-	-	-	2.2-7.2	5.3-5.4	6.4-7.1
	SD	0.2	1.4	0.2	1.4	2.8	-	-	-	-	2.6	<0.1	0.1
	COV	4.2	17.3	2.1	17.7	40.6	-	-	-	-	53.1	-.7	1.5
EPPO	n	2	1	1	2	2	0	0	0	0	1	2	2
	Average	4.9	6.7	2.6	3.2	3.3	-	-	-	-	4.5	5.9	5.5
	Min-Max	4.4-5.4	-	-	2.4-3.9	2.8-3.8	-	-	-	-	-	5.2-6.6	5.1-5.8
	SD	0.7	-	-	1.1	0.7	-	-	-	-	-	1.0	0.5
	COV	14.3	-	-	34.4	21.2	-	-	-	-	-	1.7	9

Table 27. Average percent saturation of dissolved oxygen by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		January	February	March	April	May	June	July	August	September	October	November	December
ALCR	n	2	2	2	3	2	3	3	3	3	3	3	2
	Average	96.5	90.0	92.0	92.0	93.5	84.3	72.3	74.0	64.0	88.2	91.5	96.0
	Min-Max	95.0-98.0	85.0-95.0	88.0-96.0	92.0-96.0	91.0-96.0	81.0-88.0	54.0-93.0	64.0-83.0	51.0-87.0	84.0-94.0	86.5-95.0	96.0-96.0
	SD	2.1	7.1	5.7	4.6	3.5	3.5	19.6	9.5	20.0	5.2	4.4	0.0
	COV	2.2	7.9	6.2	5.0	3.7	4.2	27.1	12.8	31.3	5.9	4.8	0.0
COCR	n	2	2	2	3	2	3	3	3	3	3	3	2
	Average	94.3	92.5	97.5	96.7	96.0	93.0	77.7	79.7	66.3	84.8	87.2	93.5
	Min-Max	90.5-98.0	87.0-98.0	95.0-100.0	90.0-100.0	84.0-108.0	90.0-97.0	60.0-94.	72.0-91.0	49.0-84.0	76.0-92.0	79.5-92.0	93.0-94.0
	SD	5.3	7.8	3.5	5.8	17.0	3.6	17.0	10.0	17.5	8.1	6.7	0.7
	COV	16.2	8.4	3.6	6.0	17.7	3.9	21.9	12.5	26.4	9.6	7.7	0.7
SACR	n	2	2	2	3	2	3	1	-	-	3	3	2
	Average	90.3	86.0	96.0	87.7	88.0	93.7	96.0	-	-	90.0	86.3	84.0
	Min-Max	90.0-90.5	80.0-92.0	92.0-100.0	86.0-89.0	86.0-90.0	86.0-100.0	-	-	-	87.0-94.0	79.0-90.0	83.0-85.0
	SD	0.4	8.5	5.7	1.5	2.8	7.1	-	-	-	3.6	6.4	1.4
	COV	0.4	9.9	5.9	1.7	3.2	7.6	-	-	-	4.0	7.4	1.7
LECL	n	2	2	2	3	3	3	3	3	3	3	2	2
	Average	96.8	97.0	100.8	102.2	104.9	95.2	90.2	93.2	90.8	94.5	94.5	95.0
	Min-Max	95.5-98.0	97.0-97.0	100.0-101.5	97.0-105.5	90.0-113.0	83.5-112.0	82.5-99.5	87.5-101.5	85.5-94.3	93.3-96.0	93.5-95.5	93.5
	SD	1.8	0.0	1.1	4.5	12.9	14.9	8.6	7.4	4.7	1.4	1.4	1.4
	COV	1.9	0.0	1.1	4.4	12.3	15.7	9.5	7.9	5.2	1.5	1.5	1.5
SBSL	n	2	1	1	2	2	2	2	2	2	2	2	2
	Average	99.5	88.0	91.0	89.5	84.0	77.0	77.5	90.0	89.0	86.3	89.5	93.5
	Min-Max	95.0-104.0	-	-	89.0-90.0	79.0-89.0	61.0-93.0	64.0-91.0	87.0-93.0	84.0-94.0	84.0-88.5	87.0-92.0	92.0-95.0
	SD	6.4	-	-	0.7	7.1	22.6	19.1	4.2	7.1	3.2	3.5	3.1

	COV	6.4	-	-	0.8	8.5	29.4	24.7	4.7	8.0	3.7	3.9	2.3
HISP	n	2	2	2	3	3	3	3	2	2	3	3	2
	Average	79.8	75.4	75.8	67.3	63.6	56.8	55.4	63.5	55.8	67.7	71.9	78.0
	Min-Max	75.5-84.0	74.5-76.3	67.8-83.8	61.3-70.8	53.0-71.5	51.8-67.0	42.5-66.0	57.0-70.0	54.5-57.0	65.5-69.5	69.5-76.3	76.0-80.0
	SD	6.0	1.2	11.3	5.2	9.5	8.8	11.9	9.2	1.8	2.0	3.8	2.8
	COV	7.5	1.6	14.9	7.7	14.9	15.5	21.5	14.5	3.2	3.0	5.3	3.6
IRSP	n	2	2	2	3	3	3	2	1	1	3	3	2
	Average	77.9	74.5	74.1	69.4	65.5	69.9	60.7	14.0	78.0	72.2	76.3	76.4
	Min-Max	75.5-80.3	72.2-77.0	65.8-82.5	64.0-74.8	51.2-78.0	44.3-87.7	50.8-70.7	-	-	58.0-80.5	73.0-80.0	75.3-77.5
	SD	3.4	3.5	11.8	5.4	13.5	22.6	14.1	-	-	12.3	3.5	1.5
	COV	4.4	4.7	15.9	7.8	20.6	32.5	23.2	-	-	17.0	4.6	2.0
CLPO	n	2	2	2	3	3	3	2	0	2	3	2	2
	Average	50.0	54.5	54.3	48.5	54.2	52.8	35.3	-	44.3	41.6	64.3	68.5
	Min-Max	46.0-54.0	42.0-67.0	45.5-63.0	41.0-63.0	50.7-58.7	50.0-55.0	31.0-39.5	-	38.0-50.7	38.5-46.0	62.0-66.5	64.0-73.0
	SD	5.7	17.7	12.4	12.6	4.1	2.6	6.0	-	9.0	3.9	3.2	6.4
	COV	11.4	32.5	22.8	26.0	7.6	4.9	17.0	-	20.3	9.4	5.0	9.3
ASPO	n	2	2	2	3	3	1	0	0	1	3	2	2
	Average	96.0	71.0	82.0	71.3	65.5	87.0	-	-	99.0	44.8	48.3	57.8
	Min-Max	96.0-96.0	61.5-80.5	81.0-83.0	55.0-84.5	39.0-92.5	-	-	-	-	22.0-64.5	48.0-48.5	57.0-58.5
	SD	0.0	13.4	1.4	15.0	26.8	-	-	-	-	21.4	0.4	1.1
	COV	0.0	18.9	1.7	21.0	40.9	-	-	-	-	47.8	0.8	1.9
EPPO	n	2	1	1	2	2	0	0	0	0	1	2	2
	Average	42.3	57.0	22.0	28.0	28.5	-	-	-	-	41.0	53.3	47.8
	Min-Max	38.0-46.5	-	-	21.0-35.0	24.0-33.0	-	-	-	-	-	46.0-60.5	43.5-52.0
	SD	6.0	-	-	9.9	6.4	-	-	-	-	-	10.3	6.0
	COV	14.2	-	-	35.4	22.5	-	-			-	19.3	13

Table 28. Average concentrations of nutrients by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV coefficient of variation (%)].

Site		UTKN	FTKN	UTP	FTP	PO4-P	NO3-N	NH3-N	SO4-S
ALCR	n	2	2	2	2	2	2	2	2
	Average	**0.310**	**.130**	**0.035**	**0.012**	**0.004**	**0.564**	**0.037**	**1.453**
	Min-Max	0.140 - 0.480	0.100 - 0.160	0.024-0.045	0.011-0.013	0.003-0.006	0.314-0.814	0.023-0.052	1.365-1.540
	SD	0.240	.042	0.015	0.001	0.002	0.354	0.021	0.124
COCR	n	1	1	1	1	1	1	1	1
	Average	**2.755**	**1.785**	**0.695**	**0.551**	**0.450**	**0.013**	**0.554**	**12.345**
	Min-Max	-	-	-	-	-	-	-	
	SD	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
SACR	n	2	2	2	2	2	2	2	2
	Average	**0.425**	**0.153**	**0.063**	**0.011**	**0.003**	**0.332**	**0.010**	**1.095**
	Min-Max	0.250-0.600	0.070-0.235	0.020-0.107	0.010-0.012	0.002-0.004	0.038-0.625	0.006-0.015	0.950-1.240
	SD	0.247	0.117	0.062	0.001	0.002	0.415	0.006	0.205
SBSL	n	1	1	1	1	1	1	1	1
	Average	**0.240**	**0.150**	**0.068**	**0.029**	**0.012**	**0.179**	**0.027**	**7.400**
	Min-Max	-	-	-	-	-	-	-	-
	SD	-	-	-	-	-	-	-	-
		-	-	-	-	-	-	-	-
HISP	n	2	2	2	2	2	2	2	2
	Average	**0.078**	**0.073**	**0.013**	**0.008**	**0.002**	**0.622**	**0.009**	**O.793**
	Min-Max	0.050-0.105	0.050-0.095	0.011-0.015	0.007-0.008	0.001-0.003	0.601-0.642	0.006-0.012	0.660-0.925
	SD	0.039	0.032	0.003	0.001	0.001	0.029	0.004	0.187

IRSP	n	2	2	2	2	2	2	2	2
	Average	0.340	0.060	0.275	0.011	0.006	0.591	0.019	1.073
	Min-Max	0.170-0.510	0.030-0.090	0.050-0.500	0.007-0.015	0.004-0.008	0.226-0.955	0.013-0.024	1.015-1.130
	SD	0.240	0.042	0.318	0.006	0.002	0.515	0.008	0.081
CLPO	n	2	2	2	2	2	2	2	2
	Average	0.645	0.520	0.065	0.025	0.005	0.196	0.047	0.415
	Min-Max	0.370-0.920	0.300-0.740	0.026-0.104	0.011-0.038	0.001-0.009	0.0-0.393	0.047-0.048	0.150-0.680
	SD	0.389	0.311	0.055	0.019	0.006	0.278	0.001	0.375
ASPO	n	1	1	1	1	1	1	1	1
	Average	2.755	1.785	0.695	0.551	0.450	0.013	0.554	12.345
	Min-Max	-	-	-	-	-	-	-	-
	SD	-	-	-	-	-	-	-	-
							-	-	-
EPPO	n	1	1	1	1	1	1	1	1
	Average	3.720	0.140	0	0.007	0.002	1.451	0.031	1.270
	Min-Max	-	-	-	-	-	-	-	-

Table 29. Average concentration of sodium, potassium, calcium, magnesium, and chloride by month by sampling location, FOCL. [n = sample size (years); min-max = minimum and maximum averages; SD = 1 standard deviation; and COV = coefficient of variation (%)].

Site		Na	K	Ca	Mg	Cl
ALCR	n	2	2	2	2	2
	Average	9.30	0.90	2.02	1.59	15.39
	Min-Max	8.40-10.20	0.86-0.94	1.79-2.25	1.50-1.69	14.90-15.87
	SD	1.27	0.06	0.33	0.14	0.69
COCR	n	2	2	2	2	2
	Average	10.38	0.93	2.60	1.95	15.99
	Min-Max	9.35-11.40	0.83-1.03	2.10-3.10	1.65-2.26	15.47-16.51
	SD	1.45	0.93	0.71	0.44	0.74
SACR	n	2	2	2	2	2
	Average	8.65	0.49	1.16	1.29	13.67
	Min-Max	7.60-9.70	0.42-0.56	1.06-1.25	1.18-1.39	13.38-13.96
	SD	1.49	0.10	0.13	0.15	0.41
SBSL	n	1	1	1	1	1
	Average	51.20	3.00	12.00	8.82	53.09
	Min-Max	-	-	-	-	-
	SD	-	-	-	-	-
HISP	n	2	2	2	2	2
	Average	6.94	0.57	2.18	1.80	11.33
	Min-Max	6.28-7.60	0.55-0.59	1.91-2.45	1.73-1.87	9.45-13.20
	SD	0.94	0.03	0.39	0.10	2.65

IRSP	n	2	2	2	2	2
	Average	11.15	0.62	2.59	2.27	15.97
	Min-Max	10.10-12.20	0.57-0.67	2.18-3.00	2.24-2.30	14.35-17.58
	SD	1.49	0.07	0.58	0.05	2.28
CLPO	n	2	2	2	2	2
	Average	8.63	1.03	1.53	1.87	18.63
	Min-Max	8.25-9.00	0.84-1.21	1.23-1.82	1.75-1.98	18.45-18.81
	SD	0.53	0.26	0.42	0.16	0.26
ASPO	n	1	1	1	1	1
	Average	16.25	2.89	8.64	7.86	18.68
	Min-Max	-	-	-	-	-
	SD	-	-	-	-	-
EPPO	n	1	1	1	1	1
	Average	7.70	0.52	1.33	1.78	-
	Min-Max	-	-	-	-	-

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural and cultural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their developement is in the best interest of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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